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System Operation

2275 Board Test Workstation

Model: 2275

(Release 7.4)

36535

~~2275~~

Form 2275-0114-D

Instruction Manual

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Controls and Indicators – Section 2
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Model: 2275
36535
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(Release 7.4)

Form 2275-0114-D

Symbol ⚠ IEC 417 on equipment signifies that the manual contains information to prevent injury or equipment damage. Refer to Page iii and to other manuals in set.

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Concord, Massachusetts, U.S.A. 01742
November, 1983

List of Effective Pages

GenRad

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

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WARNING — SHOCK HAZARD

The following instructions must be observed to prevent possible injury to personnel performing maintenance or working on the system. These warnings are affixed to system assemblies. Refer, if necessary, to the system diagrams in the Diagrams manual for the locations of the referenced assemblies.

- On the side cover of the power control assembly in the electronics bay, observe the warning, "Dangerous voltages inside. This cover to be removed by qualified service personnel only."
- on the side cover of the power control assembly in the electronics bay, observe the warning, "For continued protection against fire hazard, replace only with fuses of the same type and ratings."
- On each outside system panel, the CPU bay's sheet-metal cover plate, the protective shield over PS1 through PS4 power supplies in the electronics bay and the cover on PS5 power supply in the electronics bay, observe the warning, "Dangerous voltages inside. This cover to be removed by qualified service personnel only."
- On the back of the strip printer, observe the warning, "To prevent electrical shock, disconnect supply cord before servicing."

Other warnings:

- To avoid shock hazard, do not operate this test system without providing an adequate earth ground. See Site Preparation manual.
- To prevent injury, power must be removed before this procedure for loading paper in the strip printer is performed. See para 3.9 of System Operation manual.

CAUTION

Observe the following precautions to prevent damage to the equipment. These precautions are those affixed to system assemblies. Other sections of the manual contain other cautions.

- On the top cover of the triple power supply and on the side cover of the dc source power supply (both in the CPU bay), observe the caution, "For continued protection against fire, replace only with the same type and rating of fuse."
- On the top of the electronics cage (above the S-D/S boards), observe the caution, "Before removing an S-D/S board from the card cage, remove test head. Turn I/O connector to the closed position and pull handle from connector. Note that board lock will be loose."

NOTE

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CAPS	SCRATCHPROBING
GRnet	TRACS

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Foreword

PURPOSE OF MANUAL

This manual is directed primarily toward those production test personnel who are responsible for setting up the workstation and running production tests. It contains information for familiarizing the user with the system, information for configuring the system and selecting options, and procedures for operating the system for testing pc boards. This information is presented in sections as follows:

Section 1 -- Introduction describes the purpose and the features of a 2275 Workstation.

Section 2 -- Controls and Indicators describes the purpose and operation of operator controls and indicators.

Section 3 -- Preparing for System Operation describes the basic steps in using the test system. The user interface with the system MONITOR is described. Handling of magnetic storage media and drives and handling of printers is outlined. System start-up procedures are included.

Section 4 -- Production Test Operation presents procedures for testing pc boards. Includes handling of fixtures as well as monitor displays and operator responses.

Section 5 -- Using the Report Generator describes the data logging feature and how to generate reports from the logged data.

Appendix A -- Using GRnet describes how to connect to the optional ATE network and how to perform network operations.

Appendix B -- Using the TRACS system describes how to connect to the optional Test and Repair, Analysis/Control System and how to perform testing and analysis while using it.

RELATED DOCUMENTS

A System Manager's Guide is provided which contains information useful in managing the use of the test system.

Manuals that may be required for information necessary to design test software are:

Test Set Preparation manual
Test Programming manual
Test Library Programming manual

A Customer Training-Board User's Guide is provided as part of a user training and modeling package. This manual provides step-by-step procedures that can be run on a real pc board (included in the package) to simulate various test situations.

Refer to the Document Directory for a complete list of manuals in the document set. The Document Directory is useful in finding information within the set of manuals.

DEFINITION OF TERMS

System -- A term that refers to the workstation and related software and options.

Workstation -- The words workstation and system may be used interchangeably in this manual.

DIFFERENCE DATA

Hardware

Since the introduction of the 2275, a few hardware options have been added. These include:

Combination Printer	A printer that can be used for both diagnostic messages, program listings, and reports thus combining the function of a strip printer and a line printer.
High-Capacity Winchester	Provides a choice of drives so that more on line storage can be available.
GRnet Interface	Provides a NIM board that fits in a 2275.
Second DC Source and MUX	Provide an additional source for analog measurements.

The keyboard has also changed to provide product consistency.

Software

The only software feature that is visible to the test operator is the addition to the monitor page of the system model number in the upper right corner of the display. Refer to the 227X Test Set Preparation manual for a complete description of new software features.

Introduction – Section 1

1.1 2275 BOARD TEST WORKSTATION

The 2275 Board Test Workstation (Figure 1-1) belongs to GenRad's 227X family of testers. Each of these testers is essentially a system of electronic test instruments under computer control. This arrangement enables rapid, yet thorough, inspection of printed-circuit (pc) boards. The computer can turn on an instrument, connect it, use it to make a measurement, remember the results, and disconnect it in less time than a technician takes to turn on a bench-top instrument. While the 2275 is primarily an in-circuit tester (which tests individual components on a pc board, independent of the other components on the board), it can also be used as a bare-board tester and, in a limited manner, as a functional tester (which tests the performance of the pc board as a whole circuit). The tester is particularly effective at detecting manufacturing faults, such as wrong components, missing components, damaged components, incorrectly inserted components, and damaged etches.

The 2275's computer actually does much more than simply control the test instruments; during certain tests, for instance, it allows operator intervention: to make adjustments to components such as potentiometers, to probe the pins of an integrated circuit, or to use external test instruments. It provides graphic displays of test results and prompts; it also prints copies of test results after each test. The computer also helps the programmer to write and manage computer programs used for testing pc boards. To do all this, the computer must be capable of communicating with the operator. This capability is provided by the tester's peripheral devices: the front-panel keypad, the pushbutton, the keyboard, the video display, the strip printer, the Winchester disk drive and the floppy disk drive. These devices, diagrammed in Figure 1-2, along with the computer and the test instruments constitute the main functional parts of the 2275.

The operator uses the keypad and the START pushbutton to enter commands to the computer or to respond to prompts from it. The keypad and pushbutton provide all the capability the operator normally needs for testing pc boards. While the keyboard may also be used by the operator to test boards, it is primarily intended for use by the programmer, who needs a full set of characters for preparing test programs. The system manager usually determines whether or not the keyboard will be available for testing boards.

The video screen and the printers enable the computer to communicate prompts, messages, and results to the operator. The screen displays information quickly and is thus well suited for real-time messages. Although printouts take longer, they provide a permanent record. In the case of the strip printer, the test results and error messages for a pc board can be conveniently attached to the board if it requires repair. The optional line printer is useful primarily for program listings and log listings.

The disk drives are storage devices. They provide space for storing computer programs and information that the computer can access quickly. These programs can be compared to a handbook of test procedures and information kept at the fingertips of a technician so he can work rapidly and efficiently.

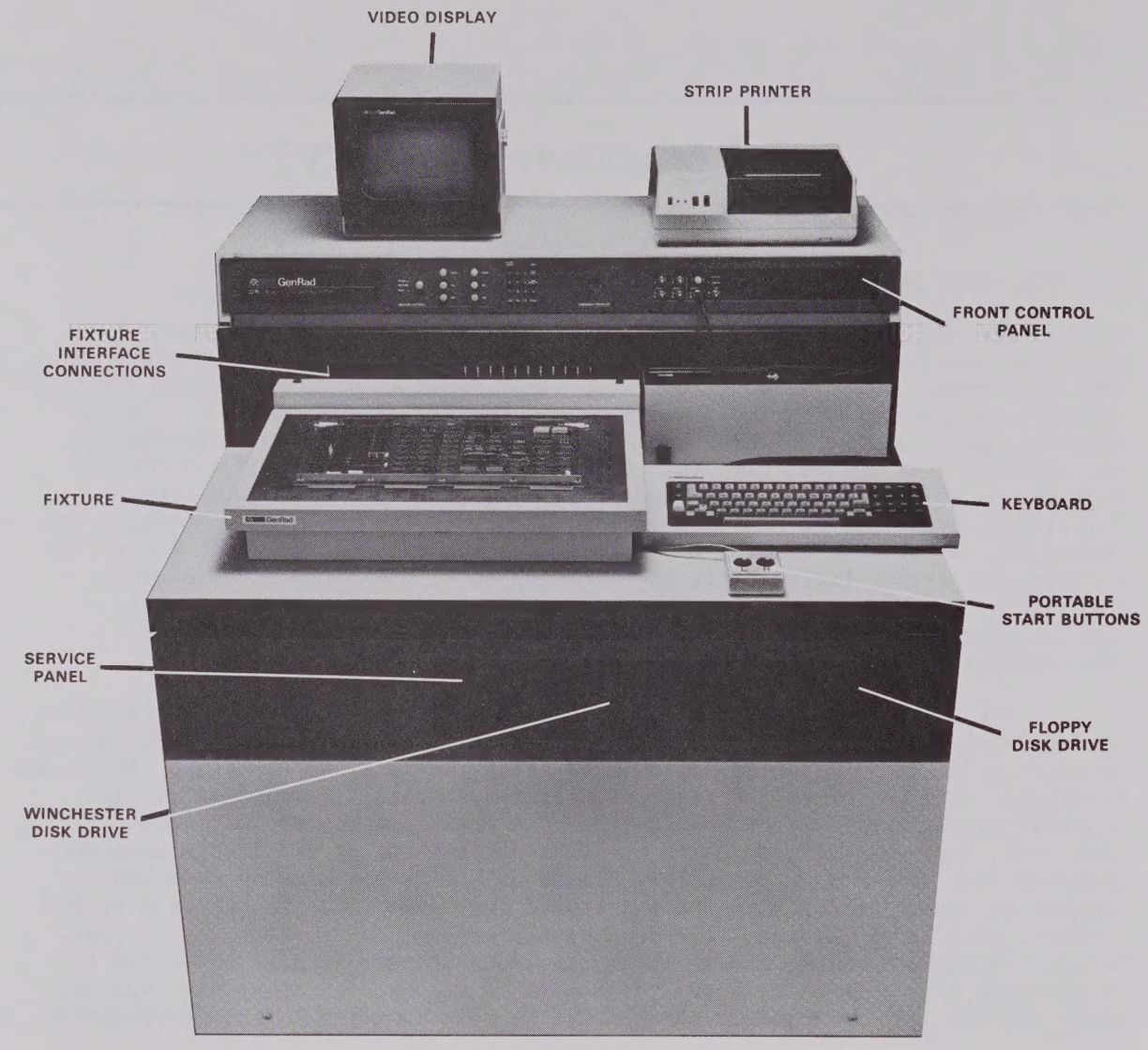

Figure 1-1. 2275 Board Test Workstation.

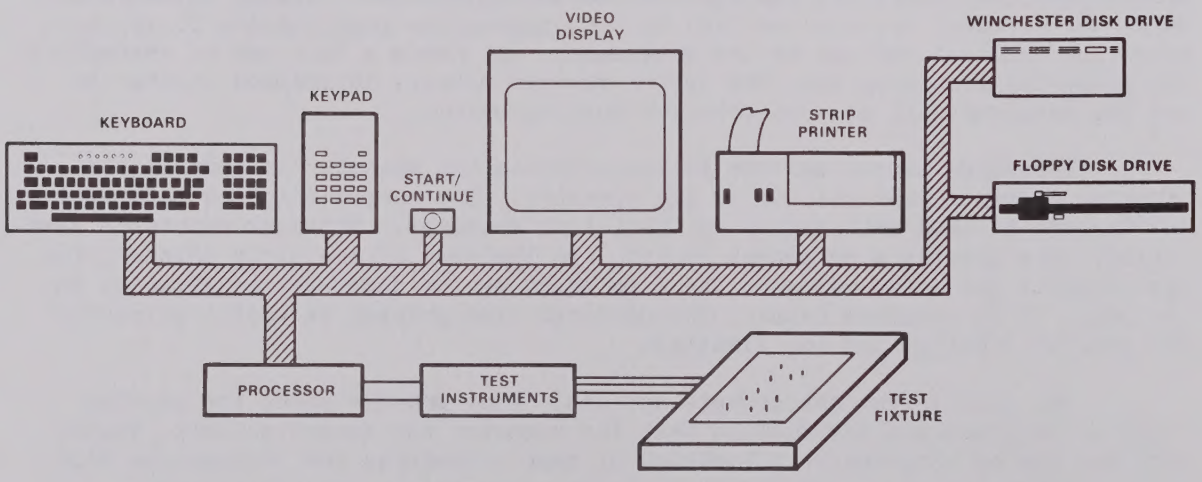

Figure 1-2. The Main Functional Parts of the 2275 Workstation.

The 2275 peripherals provide the interface between the tester and the people working on the production line. The tester also requires an interface with the circuit boards passing through the production line. Specifically, it must interface with the circuit board in a way that allows each component to be electrically isolated. This is done with a bed-of-nails test fixture, a shallow box with a perforated neoprene diaphragm for a top. Electrical connections between the test instruments and the components on the pc board under test are made with small, spring-loaded probes called test nails. Each test nail is mounted in the test fixture so that it contacts one circuit node of the pc board. When a pc board is seated properly on the neoprene, vacuum pulls the board down onto the test nails, which make contact through the perforations in the neoprene.

This hardware cannot, however, test pc boards by itself. Each board to be tested requires a test procedure, in the form of a test program, for the computer to follow. A test program is a computer program that contains a sequence of test steps, usually one for each component on the pc board, a short-circuit test and an open-circuit test. A test program must be written and a test fixture built for each different type of pc board to be tested. Test programs are generally written automatically by the Automatic Test Generation (ATG) feature. (ATG is described in the 227X Test Set Preparation manual.)

The Foreground/Background (F/B) option permits simultaneous board testing and test program development. A test programmer may edit test programs, run ATG or perform other program development tasks from a remote terminal, while an operator at the tester is testing pc boards or performing other functions. The background user's needs are serviced when the computer is not being used for testing (for example, while boards are being loaded and unloaded from the test fixture). Thus, the background user is nearly undetectable to the operator. The F/B option includes a VT10X terminal, and a line printer is recommended.

1.2 TESTING CONCEPTS

1.2.1 Types of Defects

The sooner a board defect is discovered, the easier (and cheaper) it is to repair and return the board to further assembly. To find as many defects as possible as soon as possible, the two main types of defects must be identified and dealt with.

First, there are manufacturing faults, which may consist of isolated defects in components, in connections, or in the circuit board itself. A track on the board may be broken or it may be in electrical contact with another track because of a solder bridge or defective etch. Components may be missing, they may be inserted backwards, or their pins may be bent so that they cannot mate properly with a socket. The components themselves may be defective: resistors or capacitors may have the wrong values, inductors and transformer windings may be broken, transistors may have inadequate gain, digital ICs may fail to respond correctly to their inputs. Many component defects could be discovered by the rigorous testing of the parts before they are mounted on the board, but some faults only appear after the mechanical and thermal stresses of part insertion and soldering. Manufacturing faults usually prevent a circuit board from functioning properly.

The second category of board defects includes those that appear when the components function together in a circuit. If, for example, all the tolerance errors in the parts of an analog filter section accumulate in the same

direction, the filter may exhibit performance faults, that is, it will not perform to its specifications, even though all the parts are within their specified tolerances. Likewise, a number of critical propagation delays in a digital circuit may add up to a delay that causes the circuit to malfunction, even though each of the components appears to function properly. To find these defects, the board (or a functional section of a circuit board) must be tested as a whole; apply normal input signals and power to the board, and check that the required outputs are produced.

1.2.2 Test Methods

These 2 distinct testing needs have given rise to 2 test methods, shown in Figure 1-3, which can be used at various stages of circuit board assembly.

In-circuit testing methods are used to check for manufacturing faults, that is, for defects in individual components and interconnections on the board. To test components individually, connections must be provided from the tester to all functioning component pins. This requires a special test fixture that mates with each of the board's circuit nodes and test methods that can effectively isolate a single component from the parts surrounding it. An in-circuit component test is often performed as the first or second test after a board has been assembled and soldered. (It may be preceded by a separate bare-board test to check for opens and shorts in the conductive tracks before parts are inserted.)

The in-circuit test, however, cannot verify that the circuit board or its functional units perform correctly. Hence, a functional circuit board test is often later used to find any faults undetected by the in-circuit test. With power applied to the board, this test checks that the board or chosen sections of the board produce the desired outputs when various input stimuli are applied. It may detect faults that the in-circuit test could not identify, and it may also check that further stages of assembly have not damaged the board.

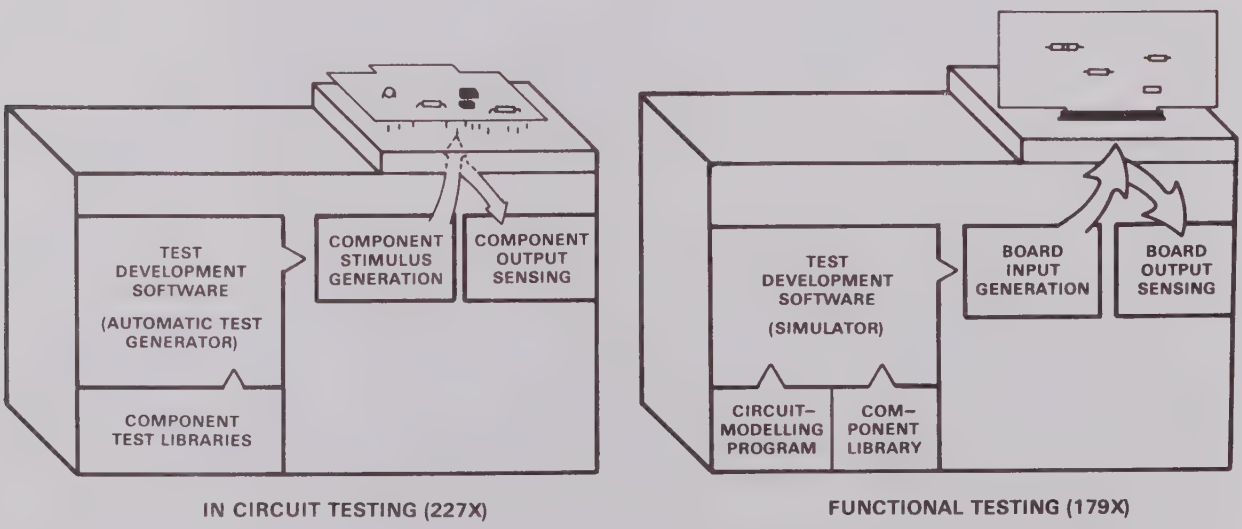

Figure 1-3. In-Circuit and Functional Testing.

1.3 HARDWARE FEATURES

The features described in the following paragraphs are standard for every 2275 Workstation.

1.3.1 Cabinet Hardware

The workstation includes a variety of specially designed modules and components that are housed in a series of interconnected cabinets, providing easy access at the front for board testing and at the rear for equipment servicing. Internal ventilation is provided by positive pressure air circulation from air intakes on the right side of the power wing cabinet.

1.3.2 Computer Hardware

The 2275 processor is a DEC LSI-11/23 [1] 16-bit microcomputer with automatic ROM bootstrap loading, power up/down protection, and a RAM memory. The 11/23 system has 124K x 16 bits of memory.

Mass Storage

All system software resides on a Winchester fixed-disk-drive unit. The user has the choice of a Rodime[2] drive with 21 megabytes of usable storage or a Maxtor[3] drive with 55 megabytes of usable storage.

Software Support Floppy Disk

The software support device, a Tandon[4] floppy disk drive system, is used to install software updates and to load system diagnostic programs. It also provides a convenient means of storing many board test programs, library elements and circuit descriptions used on the system. The software support device also provides a means for documenting test cases, application programs, and customer problems, thus making GenRad customer support more efficient. The software support device is used as a product service device in the event of a system disk-drive failure.

Video Display

The video screen displays alphanumeric data in a 24-line by 80-character format. The screen is used during program preparation and during the testing sequence to display commands, error messages, and other operator information. It includes an adjustable pivot mount that enables rapid selection of the optimum viewing angle.

Keyboard

A plug-in 72-character keyboard connects to the measurement bay control panel. The keyboard is used for preparing programs and selecting monitor options.

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[1] Registered trademarks of Digital Equipment Corp., Maynard, MA 01754.
[2] Rodime Ltd., El Toro, CA 92630.
[3] Maxtor, Santa Clara, CA 95134
[4] Tandon, Chatsworth CA 91311.

Keypad

A calculator-size control keypad allows easy access to the GenRad software monitor for calling up and running test programs.

Pushbutton

A portable START pushbutton is provided for convenient control of test program execution.

Printers

One of the following printers must be selected to provide diagnostic production testing.

1. A Centronics[1] P-1 Microprinter (strip printer) that is software controlled to provide various sized characters on 12.5 cm (4.75 in.) wide aluminized paper.

2. A Mannesmann Tally[2] MT160 printer that is software controlled to print various sized characters or graphics symbols on 21.59 cm (8-1/2 in) plain paper. This printer can also be used for listing test programs and report files.

1.3.3 Test Hardware

The following test hardware is standard on all 2275s.

Power Supply

A Lambda[3] Model LOT-W-5152A fixed power supply provides ±15 V at 0.75 A maximum and +5 V at 3 A maximum to the receiver interface for UUT power or other applications, as needed. The power supply is connected and disconnected under program control but the output levels are non-programmable.

Analog Instrumentation

Analog source and measurement instruments include:

Precision DC Sources (DCS). The tester contains a precision DC Voltage source (DCV) and a precision DC current source (DCI). The DCV is programmable from 0 V to ±16 V over 4 ranges. In addition, current flow to a UUT is current limited to within either a 160-mA or 25-mA (±20%) selectable limit. The DCI is programmable from 0 mA to ±128 mA over 6 ranges with 16 V of compliance. The output may also be turned ON or OFF under program control.

A DC Measurement Meter (DCM). The voltmeter (DCV) section can measure voltages from 0 V to ±128 V over 5 ranges. The ammeter (DCI) section can measure current from 0 mA to ±128 mA over 8 ranges.

[1] Centronics Data Computer Corporation, Hudson, NH, 03051.
[2] Mannesmann Tally Corporation, Kent, WA 98032.
[3] Lambda Electronics Corporation, Melville, L.I., NY 11746.

An AC Impedance Meter (ACZ). The unit contains both ac source and ac measurement sections that may be used to measure complex impedance and admittance parameters (resistance, capacitance, and inductance) at 1 of 3 selectable frequencies (100 Hz, 1 kHz or 10 kHz) and at 2 selectable test voltages (0.2 or 1 V rms).

Instrument source and measurement data are calculated by the software to expand the range of tests performed. For example, by forcing a known voltage from the dc source and measuring the unknown current, the software computes the value of dc resistance under test by using Ohm's Law (R=E/I).

Analog Instrument Multiplexer and Pin Scanner

Analog testing capability is provided by a multiplexed, pin-scanner system that interconnects the analog source and measurement instruments to the bed-of-nails test fixture. In the standard system, up to 9 input and 9 reference lines can be switched, under program control, to 4 multiplexed output channels that are distributed via scanner relays and further expanded by the nail expander to individual probe contacts (nails) in the fixture. There is scanner switching capability for controlling 32 hybrid test nails on each Dual Scanner Driver Sensor (DSDS) board.

Digital Driver/Sensor Instrumentation

Digital testing capability is provided by a driver/sensor system that can, under program control, force logic levels or monitor logic output states on a test fixture nail. A 1K (1-bit) memory is associated with each driver/sensor pin to allow high-speed burst testing of digital ICs. The test program for each IC is preloaded in memory at I/O speed but executed by the driver/sensor system at a much faster burst speed. Each digital driver/sensor board is capable of controlling digital or hybrid test nails.

Pin Multiplexer

The analog and digital test systems are connected to the fixture pins by a multiplex switching system. Since driver/sensors are shared among bursts, a large number of hybrid nails is possible.

Test Pin Configurations

Several standard system configurations are available, which provide capability for testing various size pc boards. The minimum 2275 system configuration supports 320 hybrid circuit nodes; the maximum configuration supports 640 hybrid circuit nodes.

Special Instrument Disconnects and Drivers

A system relay driver board (PIO-0) contains relay drivers for connecting the optional user power supplies to the UUT under program control. It also contains 4 TTL(transistor-transistor logic) drivers for user applications.

GenRad Probe

The GenRad Probe is an analog/digital probe with switchable access either to the analog instruments or to a digital driver/sensor. This probe can be used to make Kelvin measurements and to check continuity in the digital portion of the test fixture.

Sync Pulse Output

Provides easy access to timing pulses while a digital test is running. The pulses are convenient for synchronizing oscillo- scopes, logic analyzers, counters, etc during the digital debug phase of program preparation.

1.3.4 Optional Hardware

The major items that are optionally available for use with a 2275 Board Test Workstation are described in the following paragraphs. Consult the maintenance manual for a complete list of all available options. The use of each option is described in the 227X Test Set Preparation manual.

Mass Storage

A second Winchester drive can be added, if it is the same type as the first Winchester drive.

Network Interface Module (NIM)

The NIM module is an optional interface circuit board that provides a data path linkage between the workstation and a central computer via GenRad's high-speed transmission network (GRnet).

IEEE-488 Bus

The IEEE-488 Bus Option comprises an IEEE-488 Bus controller, a bus interface connector, and nine BNC connectors. When this option is included, any IEEE-488 compatible, programmable instrument may be connected to the bus.

DC Source

A second dc source and multiplex is available.

Vacuum Pump

The optional rotary vane pump and control kit is used to generate sufficient vacuum at the test fixture to seat pc boards on the fixture.

Line Printer

An optional line printer provides rapid printouts of all test system messages, test programs, and user files.

Programmable Power Supplies

There are several programmable power-supply options available; refer to Table 1-1. The UPS supplies are fully programmable through statements in the test language. TPS supplies may be programmed to OFF, LOW, NORMAL, or HIGH values. The actual values programmed are set by resistors which are mounted on a connector that mounts in the board fixture. The High Current Supply (HCS) is controllable via optional dc sources, DCS(n). The available output levels are shown in Table 1-2.

Table 1-1
USER POWER-SUPPLY OPTIONS

Power Supply	Maximum Availability
TPS	1
UPS (10 V, 20 V, 40 V)	any 3 if no 80 V, 1 otherwise
UPS (80 V)	1 if not more than one 10-V, 20-V, or 40-V UPS

Table 1-2
MAXIMUM OUTPUT LEVELS OF OPTIONAL POWER SUPPLIES

UPS*	TPS
± 10 V at 4 A	0.5 - 7 V at 7.5 A
± 20 V at 2A	0.5 - 20 V at 3 A
± 40 V at 1 A	0.5 - 20 V at 3 A
± 80 V at 0.5 A	

*The UPS box has 3 slots available. The 10-V, 20-V, and 40-V supplies take 1 slot each; the 80-V supply takes 2 slots.

Bar-Code Wand

The bar-code wand provides a means for quick and accurate entry of bar-coded information (board serial numbers, etc).

1.4 SOFTWARE FEATURES

The software package allows test programs to be prepared and boards tested in a rapid and efficient manner. Test programs may be prepared automatically through use of ATG or manually through use of a choice of editors. Test programs are prepared in a high-level test language that, because of its English language characteristics, is easily read and understood. Following are some of the major features of the software.

Automatic Loading

The software is automatically loaded whenever test system power is applied.

Monitor

There are 2 monitor access levels (limited and unlimited) that are selected by the software. The unlimited monitor allows access to all operating modes for program preparation, debugging, and testing. The limited monitor allows access only to those modes actually needed for device testing, thus preventing unauthorized personnel from modifying completed programs or files.

File Management

An extensive file management mode enables an operator to list directories, to copy or delete files, to format disks, etc.

Data Collection

A statistical data collection feature enables test data to be gathered rapidly and efficiently. The Logging Report Generator mode allows a variety of reports and plots to be generated from the collected data.

Automatic Test Generator

The ATG software automatically generates test programs from simple, table-formatted, circuit-topology descriptions. The ATG software analyzes information obtained from the descriptions (such as UUT component and interconnection data), selects appropriate tests from an extensive analog and digital library, and automatically outputs a source test program for testing the UUT.

Library

A library management mode allows for listing system libraries, modifying the User Analog Test Library and for copying, adding to, deleting from, or renaming tests in the User Digital Test Library and User Analog Component Library. Users may also create their own Analog and Digital Test Libraries and Analog Component Libraries, as desired.

Editor

An Editor mode is used for preparation and correction of files (test programs, circuit-topology descriptions, etc).

Translate Mode

The Translate mode compiles the ASCII source files into compact binary object files that may be used in the Diagnose and Debug modes to test boards. Source files are checked for incorrect syntax and other errors.

Diagnose Mode

The Diagnose task tests the UUT, using the translated binary object file. Options within this mode enable operators to test UUTs rapidly and efficiently and to provide various forms of test data.

Debug

Interactive features of the diagnose software enable completed test programs to be rapidly debugged and corrected on-line.

Batch Mode

Batch mode allows the system to execute, sequentially, monitor commands specified in a batch input file.

Nail Assignment Mode

Multiplexed testers allow several test nails to share the same driver/sensor. Proper assignment of test nails to a test set is of primary importance. The nail assignment software program performs this function and provides the user with a wire list for wiring the fixture.

Compatibility Among 227X Testers

Test programs are, in many respects, the same for all 227X testers. Most of the differences are caused by the different nail assignment requirements of each tester.

In spite of these differences, methods are available to provide software compatibility among 227X testers. By means of the emulation mode, a test set that was originally developed for one system can be adapted for use on another.

Networking

A networking utility allows full use of an installed GRnet networking system. This system permits development, storage, and management of data files (test programs, text files, etc) at a central programming station.

Test and Repair Analysis/Control System (TRACS)

The TRACS system is an automated test and repair loop control system that ties ATE test stations, analysis stations, and repair stations to a central database with the high-performance GRnet network. The TRACS system collects data during the production process and produces reports that can help improve manufacturing and test methods.

1.5 TEST FIXTURES

The UUT is tested on a bed-of-nails test fixture that allows the tester access to a large number of internal circuit nodes. Test fixtures are wired specifically for the unit to be tested and interconnect the UUT with tester analog source and measure instruments, digital driver and sensor circuits, power supplies, etc through a ZIF connector interface. The UUT is placed flat against the top surface of the test fixture and is pulled down, by the vacuum system, onto the spring-loaded bed-of-nails probe contacts.

Fixtures can be ordered from GenRad, ready to use, for each UUT for which the necessary information is provided. Fixture kits are also available which provide material for the user to drill and wire on-site. Refer to the Fixture Kit manual for details and for assembly procedure instructions.

1.6 MULTI-USER TEST SYSTEM

Multi-user systems (Foreground/Background option) contain all the hardware features described in para 1.3 of this manual, plus a DEC VT10X video display terminal with interconnecting cable, which is included for the background user. Modified software is also provided for running the background terminal.

All optional features available with the basic system are also available with multi-user systems. Note that, if the background user intends to list many files, GenRad recommends that the optional Printronix[1] line printer and line printer interface board be purchased with the F/B option.

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[1]Printronix Inc., Irvine CA 92714.

Controls and Indicators – Section 2

2.1 INTRODUCTION

Detailed descriptions of the controls and indicators for peripheral equipment not manufactured by GenRad (such as the processor, line printer, etc) are included in the manufacturer's manuals available with each test system. Controls and indicators for GenRad-manufactured equipment are described in the following paragraphs.

2.2 DISPLAY

The video display (Figure 2-1) is used to display monitor options, prompts and test status. Test results and diagnostic messages are shown on the display. The display is also used with the probing function.

BRIGHTNESS and FOCUS controls are mounted on the rear panel of the video display.

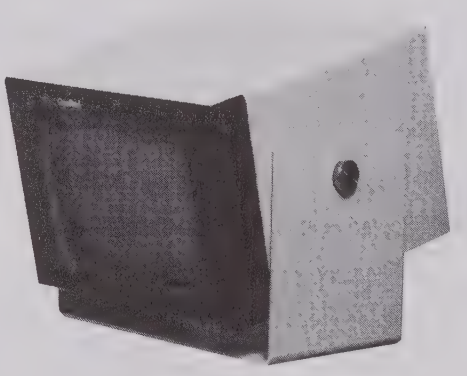

Figure 2-1. Video Display.

2.3 FRONT PANEL

The front panel provides: controls for the vacuum system, connectors for probe and synchronizing features, an emergency shut-off and pushbuttons for test control. These are shown in Figure 2-2 and are described in Table 2-1.

Figure 2-2. Front-Panel Controls.

Table 2-1
FRONT-PANEL CONTROLS

Item	Description
MONITOR ENABLE Key	Used to return control to the monitor options page.
0 - 9 Keys	Used to select numerical test names and batch files.
LOAD PROGRAM Key	Loads the program.
ENTER Key	Executes selected monitor options or enters indicated data.
YES Key	Answers YES to [Y/N] monitor options.
NO Key	Answers NO to [Y/N] monitor options.
RESET Key	Resets program to the beginning.
CLEAR ENTRY Key	Deletes 1 digit from the current entry each time that the key is pressed.
EMERGENCY POWER-OFF pushbutton	Causes an immediate removal of all system power.
VACUUM Controls	The vacuum system is capable of supplying vacuum to 2 fixture chambers simultaneously. The function of the vacuum panel switches is to control the air flow lines, either under program control or manually. When a single test fixture is used, the right-hand vacuum port must be used. If additional vacuum is needed, the left-hand port can also be used. The right-hand set of pushbuttons controls the right-hand port and the left-hand set the left-hand port.
SINGLE/ DUAL FIXTURE	When in the Dual (out) position, each vacuum port is controlled individually. In the single (in) position, both ports are controlled by either set of swiches.
AUTO	Enables vacuum to be controlled under system program control.
ON	Manually applies vacuum.
OFF	Manually removes vacuum.
WAND Connector	Instead of using the keypad or keyboard, connect the optional wand that can be used to enter bar-code data.
PROBES	
analog/digital pushbutton	Pushing this switch in (latching it) to the ANALOG position connects the GenRad probe to output lines EXTA, B, C, D of the Self-Test Module (STM) and connects the associated BNC connector and test point to lines EXTA and C. Pushing the switch in again (releasing it) sets it to the DIGITAL position, connecting the probe, BNC connector, and test point to a user-selected driver/sensor.

Table 2-1 (continued)

Item	Description
PROBES (cont)	
probe BNC and test point	The probe connectors are essentially in parallel with one another and are wired in the test fixture to a dedicated driver/sensor. The BNC connector is used for the GenRad probe and the test point allows another user access to the probe signal.
+5 V BNC connector	A +5 V output available at the panel, for powering commercial logic probes.
Ground connector	Digital ground.
STROBES	In debugging and verifying digital tests, the strobe connectors provide a convenient way to synchronize external equipment, such as oscilloscopes, counters, etc, to the digital test steps. The BNC connectors or the test points can be used to provide a pulse.
test step 1 BNC and test point	Pulse whose leading edge is synchronized with the first test step in a burst.
test step N BNC and test point	Pulse whose leading edge is synchronized with a program-controlled test step and generated by a user-specified driver/sensor.
driver BNC and test point	Pulse synchronized with, and occurring during, each transfer of pin data to the digital drivers.
sensor BNC and test point	Pulse synchronized with the acquisition of state data from the logic sensor outputs.

2.4 START BUTTONS

When one of the START pushbuttons is initially pressed, it clears the hardware and initiates a test program. During test program operation, it is used to continue testing following a programmed pause that requires operator response. The START pushbutton cable connects to a connector on the front of the pencil tray. When single fixtures are used, either the left or right pushbutton can be used to control the test. When dual fixtures are used, the corresponding pushbutton must be used for the left and right sides of the fixture.

2.5 KEYBOARD

A plug-in, standard, 72-character keyboard allows the operator to access the monitor and to enter commands or other data to the processor for editing and programming operations. The keyboard, shown in Figure 2-3, plugs into the connector labeled KEYBOARD on the right side panel (Figure 2-4). Refer to Sections 3 and 4 for operator use of the keyboard. Refer to the 227X Test Set Preparation manual for expanded monitor control functions and editing functions.

Figure 2-3. Keyboard Keys.

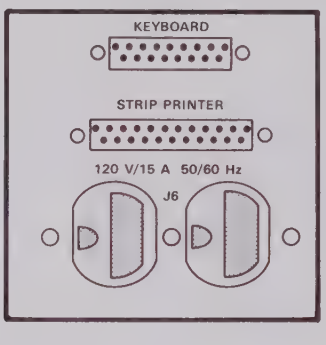

Figure 2-4.
Side Connector Panel.

2.6 SERVICE PANEL

Normally, the system is booted and initialized when the system power switch is turned on. The system may be rebooted and initialized while power is on by pressing the service panel boot pushbutton.

The purpose of the service panel is to provide system diagnostic information. Refer to the service manual for a description of all other service panel functions. For normal operation, the WO WRITE PROTECT switch should be off and the DISK DIAGNOSTIC MODE switch should be in the POWER UP position. See Figure 2-5.

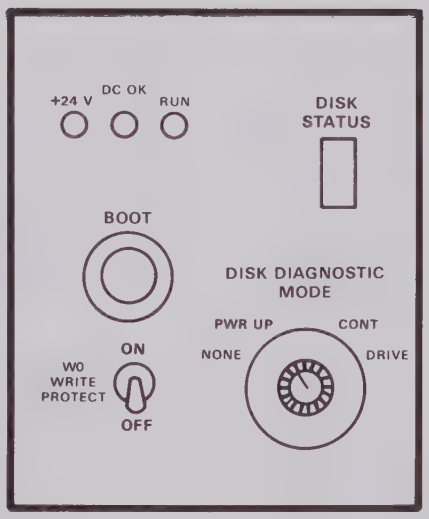

Figure 2-5. Service Panel.

2.7 COMBINTATION PRINTER

The combination printer produces a hard copy of diagnostic messages and test programs and reports. The printer interface connector is the one labeled "strip printer" on the side panel (Figure 2-4). The controls and indicators are shown in Figure 2-6 and listed in Table 2-2. Refer to the Mannesmann Tally MT160 Operator's Manual for more complete instructions.

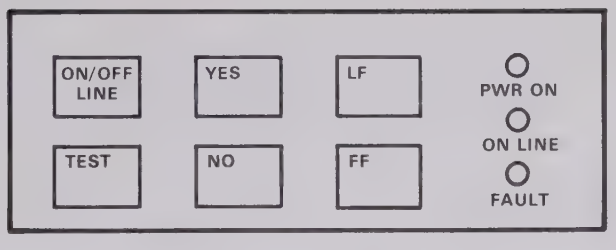

Figure 2-6. Combination Printer Controls.

Table 2-2
COMBINATION PRINTER CONTROLS

ON/OFF LINE	Press to toggle ON and OFF LINE condition. Printer cannot receive data when OFF LINE.
TEST	Runs an off-line print test. Press again to stop test.
YES	Used in programming mode to select print format.
NO	Used in programming mode to select print format.
LF	Press momentarily for a single line feed. Hold pressed for continuous line feed.
FF	Press momentarily for paper to advance to top of next page.
PWR ON	Indicates power switch is on.
ON LINE	Indicates printer is on line and can accept data.
FAULT	On steady when out of paper. Flashes if there is a print head obstruction.
Power Switch	Switches power to printer. Located on left side of unit.

2.8 STRIP PRINTER

The strip printer produces a hard copy of monitor diagnostic. It may be selected in place of the combination printer. The strip-printer interface connector and ac connector (Figure 2-4) are mounted on the right side panel. An alternate connector is located on the rear panel. The strip-printer controls are shown in Figure 2-7 and listed in Table 2-3.

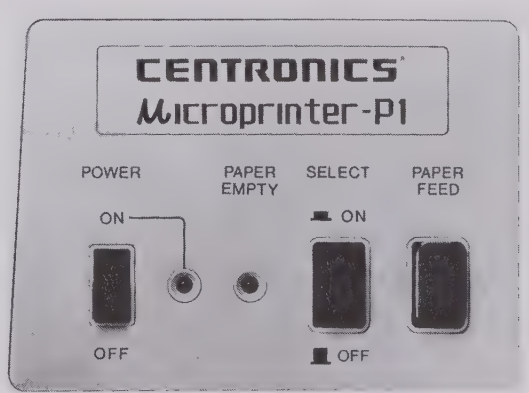

Figure 2-7. Strip-Printer Controls.

Table 2-3
STRIP-PRINTER CONTROLS

Item	Description
POWER Switch	Turns power on and off in the printer. Printer is on when POWER lamp is lighted.
POWER Lamp	When lighted, indicates power is applied to the printer.
PAPER EMPTY Lamp	When lighted, indicates the printer is out of paper (approximately 3 lines remaining). When paper first runs out, an audible tone is sounded for 2 seconds and the printer goes busy.
SELECT ON/OFF Switch	When ON LINE, printer can receive data from the system. When OFF LINE, printer cannot receive data but the system waits for the switch to be turned on if data are directed to the printer.
PAPER Feed Switch	When pressed, causes paper to advance. Paper will advance as long as the switch is pressed.

2.9 WINCHESTER DISK-DRIVE

The Winchester disk drive is controlled automatically by the software. It is turned on when the main power switch is turned on and is ready to be used as soon as the processor is ready. There are two indicators visible through the dark tone panel on the front of the workstation. One is lighted whenever power is on. The other flickers as data are being accessed by the drive.

One drive is standard equipment; a second drive is optionally available.

2.10 FLOPPY DISK DRIVE CONTROLS

The floppy disk drive is controlled automatically by the software. It is turned on when the main power switch is on, a disk is inserted, and the front lever is in the down position. An indicator is on when these conditions exist. See Figure 2-8.

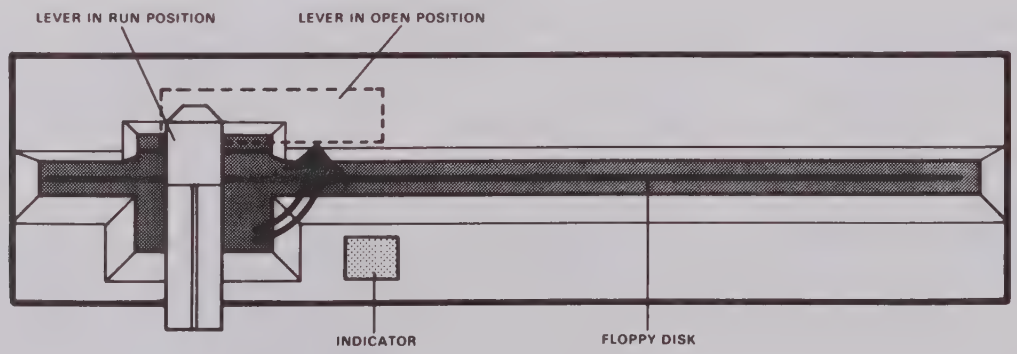

Figure 2-8. Floppy Disk Drive.

2.11 REAR-PANEL CONNECTORS

Connectors for the video display and connectors for optional equipment are mounted on the rear panel of the workstation, as shown in Figure 2-9 and described in Table 2-4.

Table 2-4
REAR-PANEL CONNECTORS

Item	Description
Ac Outlet	Duplex 120V, 15A, ac outlet for optional equipment such as line printer and background terminal.
FOOTSWITCH	Connector for optional footswitch which can be used in place of the START pushbutton.
LINE PRINTER	Connector for optional Printronix line printer interface signals.
MODEM	Connector for optional network communication modem.
FOREGROUND/ BACKGROUND	Connector for optional background VT10X terminal.
IEEE	Connector for General Purpose Interface Bus (GPIB) used to automatically control external programmable instrumentation.
INSTRUMENTATION MULTIPLEXER	Nine connectors for inputting or outputting signals between the workstation's optional instrumentation multiplexer and external equipment being controlled by the IEEE GPIB.
MONITOR	Connector at top of panel is for the CRT Video Display.
KEYBOARD	Alternate connector for the keyboard.

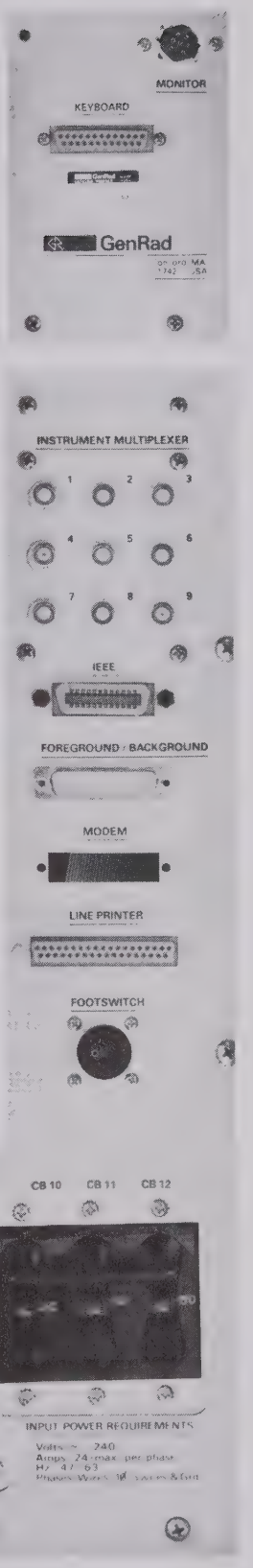

Figure 2-9.
Rear-Panel Connectors.

2.12 POWER CONTROLLER

The main power circuit-breaker switches (CB10, CB11, CB12) are accessed through the rear panel of the workstation shown in Figure 2-9. The 3 switches each control a 120-V single-phase circuit and they are tied together to control all power as one switch.

There are 6 circuit-breaker switches that control the individual circuits in the workstation. These are located behind the left side panel.

2.13 PRINTRONIX LINE PRINTER (Optional)

This printer is recommended as an output device for the multi-user configuration. The controls and indicators are illustrated in Figure 2-10 and listed in Table 2-5.

2.14 BACKGROUND TERMINAL (Optional)

When the Foreground/Background option is present, there is a DEC VT10X terminal added to the workstation. This terminal, which includes a video display and full keyboard, is primarily used for developing test programs. It cannot be used to run tests because it cannot address test hardware. Refer to the 227X Test Set Preparation manual for use of this terminal in generating test programs.

Table 2-5
CONTROLS AND INDICATORS
PRINTRONIX P300 PRINTER

Control/Indicator	Function
Power on/off toggle switch	Turns on ac power to printer.
POWER indicator	Lighted when ac power switch is on.
CHECK pushbutton/ indicator	Lighted when: -paper is not loaded, -paper has run out, -paper is jammed, or -any internal supply voltage is abnormal. Light goes out when fault is cleared, except CHECK pushbutton must be pressed after paper motion fault is cleared.

Table 2-5 (Continued)

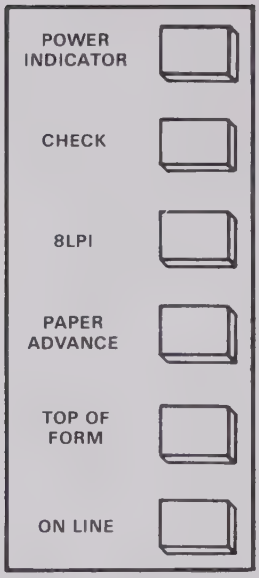

Figure 2-10.
Printronix P300 Printer
Controls and Indicators.

Control/Indicator	Function
8LPI pushbutton/ indicator	Momentary-action switch selects line spacing of either eight lines per inch (lighted) or six lines per inch (unlighted). Operational at Operator Panel only when printer is off-line.
PAPER ADVANCE pushbutton	Press to advance paper.
TOP OF FORM pushbutton/ indicator	Momentary-action switch causes paper to advance to top of next form. Operational only when printer is off-line. A lighted pushbutton indicates that special EVFU has been enabled.[1]
ON LINE pushbutton/ indicator	Momentary-action switch enables printer control through the interface (lighted) or disables the interface (unlighted). Printer cannot go on-line if the CHECK indicator is lighted.

[1] Electronical Vertical Form Unit (EVFU) is a software-controlled vertical formatter. Refer to Printronix Application Note No. 102374, "Using the Electronic VFU," for operating instructions. Available from Printronix on request: Printronix, P.O. Box 19559, Irvine, CA 92714, (714) 549-7700.

Preparing for System Operation — Section 3

3.1 INTRODUCTION

Preparing and using the workstation for testing pc boards involve a few actions described in this section:

Start-up
Shut-down
Loading printer paper
Inserting floppy disks

How to use the monitor to tell the system to perform testing activities is also described.

Procedures described in this section may be the responsibility of test operators, test programmers, or system managers, as decided by the system manager at each site.

The various controls and indicators on the workstation are described in this section to the extent needed for each procedure. A more complete description is given in Section 2; a review of that section may help familiarize a user with the workstation.

3.2 THE MONITOR

3.2.1 Monitor Access

The test operator interfaces with the test system by responding to the menu-style displays that appear on the video screen. When the test system is being used for production test only, the monitor capability may be set to a limited level of operation. If program preparation is to be performed, the monitor level must be set for an unlimited level of operation. When UNLIMITed access is enabled, the system can be used for test program preparation, as well as for board testing. Selecting the access level can be done only by a qualified user who has a valid password. System managers and test programmers have access to all monitor modes for disk-file management and program preparation. Monitor operation with UNLIMITed access enabled is described in the 227X Test Set Preparation manual.

The LIMITed access level is provided to reduce the number of options and selections an operator must respond to before testing can begin and to protect the software during normal production testing. From the LIMITed level, test system operators have access only to the Test sub-mode of Diagnose mode for board testing. Section 4 describes system operation from the LIMITed access level of the monitor only. If it is necessary, operators can be given access to other modes through batch files created by the system manager.

3.2.2 Selecting Options

When a test run is being started, several options on the Diagnose page must be specified via the keyboard. The procedures for specifying options are briefly presented here. A more detailed description is presented in the 227X Test Set Preparation manual.

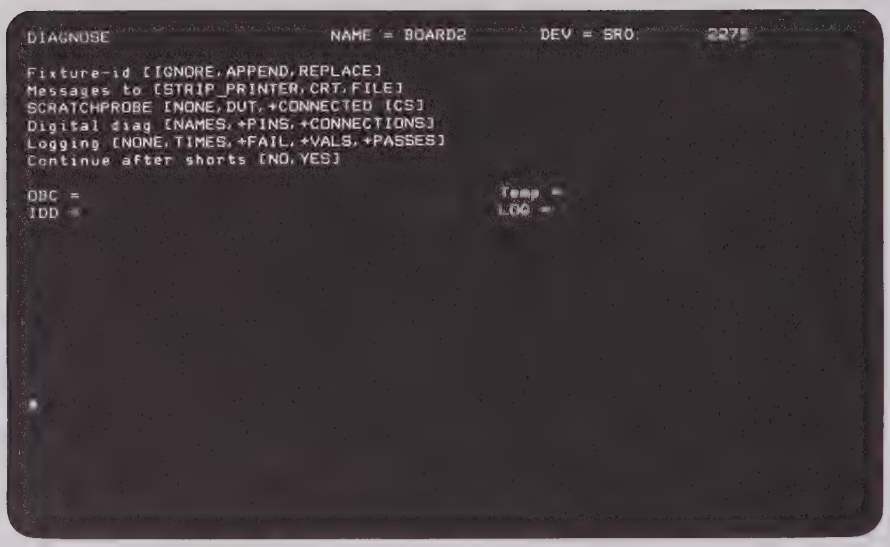

Figure 3-1. Diagnose Options Page with LIMITed Monitor Access Enabled.

The first step is to position the cursor at the desired option. If the cursor is at the prompt (#) at the bottom of the Diagnose page, as shown in Figure 3-1, press the down arrow key and the cursor is positioned at the first option, the NAME = option. Press the down arrow key again and the cursor is positioned at the next option, which is the DEV = option. Each time the down arrow key is pressed, the cursor is positioned at the next option. The cursor can be moved through all the options and back to the prompt. Pressing the up arrow key moves the cursor in the opposite direction. Pressing the MARK key moves the cursor back to the prompt.

There are 2 types of options on the Diagnose page: file specification and multiple choice. Fill in the file specification options by moving the cursor to the option; if the option field is blank, type in the file information. If the option field has file information present, delete that information by pressing the CTRL K key; the new file information can then be entered. The CTRL K key deletes any part of a file specification entry that exists from the cursor location to the end of the entry.

Press the right arrow key to move the cursor from one character to the next within a file specification option. Move the cursor in the reverse direction by pressing the left arrow key.

Example

The Diagnose page shown in Figure 3-1 is currently displayed. The next board to be tested has a test program whose file device and name is SR1:PCBD3. Change the NAME = and DEV = options for the new board.

a. Press the down arrow key once to set the cursor at the beginning of the existing entry for the NAME = option.

b. Press the CTRL K key to erase the existing entry.

c. Type PCBD3.

d. Press the down arrow key (or RETURN key) to set the cursor at the beginning of the existing entry for the DEV = option.

e. The 0 must be changed to a 1, so press the right arrow key 3 times to position the cursor at the :.

f. Press the DEL CHAR key to erase the 0.

g. Type a 1.

h. Press the MARK key to return the cursor to the prompt.

At system initialization, the system defaults to the left-most choice in all multiple-choice options. To select another choice within that option, use the right or left arrow keys to move the cursor to the desired choice. The choice at which the cursor is located is automatically selected and remains selected until the cursor is moved to a different choice.

Example

Assume that the Diagnose page shown in Figure 3-1 is currently displayed. The user wants the name of the test program for the next test run to be the name currently specified as BOARD2 but with the Fixture-ID appended to it. Also, the logging feature is not to be used. Therefore, the Fixture-id and Logging options must be changed.

a. Press the down arrow key 3 times to position the cursor at the IGNORE choice of the Fixture-id option.

b. Press the right arrow key to change the selected option from IGNORE to APPEND. The APPEND is now in reverse video.

c. Press the down arrow key 4 times to position the cursor at the previously selected TIMES selection of the logging option.

d. Press the left arrow key to change the selection to NONE.

e. Press the MARK key to return the cursor to the prompt.

3.2.3 Entering a Command

Several commands can be executed from the LIMITed access Diagnose page. Enter the commands by typing the command name when the cursor is at the prompt. The commands of particular concern to the test operator are defined in Table 3-1.

Example

The operator wishes to get some information about SCRATCHPROBE options.

a. Type HELP SCR to position the cursor at the NONE selection for the SCRATCHPROBE option and to display a message that tells what the NONE option does.

b. Press the right arrow key to select the DUT option and observe the message that tells what the DUT option does.

c. Press the right arrow key again to select the +CONNECTED IC's option and observe what that option does.

d. Move cursor to desired choice.

e. Press the MARK key to return the cursor to the prompt.

Table 3-1

OPERATOR DIAGNOSE COMMANDS

Command	Function
HELP	Displays helpful information. The first time HELP is called, a description of the current monitor page appears, along with instructions for obtaining more system help via a series of descriptive pages. When the series is completed (or the user aborts the HELP series), the monitor options page from which HELP was called is returned to the screen. An option name can be included in the command to get help on a specific option or file specification. For example, if the "Logging" option is set to NONE, entering #HELP LOG displays the help message: Data logging is disabled and the cursor is positioned at NONE in the Logging option.
PAGE	Re-writes the currently displayed monitor options page. Useful when a system message disturbs the display.
RUN	Loads the test program and enters TEST mode so that testing of boards can proceed.
SHU or SHUTDOWN or ABORT	Exits from the GenRad monitor and returns system control to the RSX-11M operating system.

3.2.3 Entering a Command

Option Name= Specify a file by typing the option name= file specification. This method of specifying an option is an alternative to that described in para. 3.2.2. For example,

#DEV = AL:

specifies the device name.

3.3 SYSTEM SOFTWARE

GenRad's 2275 Board Test Workstation is equipped with a Winchester disk drive that includes fixed (non-removable) disks. All GenRad system software required for normal operation is recorded on the disks prior to system shipment. It is, therefore, not generally necessary to load any GenRad software prior to starting-up a test system. Software reloading procedures are described in the 227X System Managers Guide

User software may have been put directly on the Winchester media at Test Set Preparation time, or it may have been put on a floppy disk. Paragraph 3.7 describes the use of floppy disks for test programs.

3.4 TEST SYSTEM START-UP

System start-up is essentially an automatic process. When the power circuit breaker switches (CB10, CB11, CB12) in the rear of the workstation are turned to the ON position the following events take place automatically.

a. A self-test diagnostic routine is performed. In the case of a failure, a diagnostic message is displayed on the CRT and start-up is aborted.

b. A waiting time allows the temperature of the processor to stabilize and allows the Winchester disk drive to reach operating speed and temperature. One of the Winchester drive indicators should be on steadily.

c. The processor is bootstrapped (operating software is loaded).

d. The monitor is initialized as denoted by a series of messages, and the Diagnose page is displayed. The system is ready for operation.

3.5 TEST SYSTEM SHUT-DOWN

Use the following procedure to shut-down the test system.

a. If the top-level monitor page is not showing on the video display, press the MONITOR ENABLE button on the test system keypad or type the command MONITOR to return system control to the top-level monitor.

b. Type ABO (Abort) or SHU (Shutdown) and press RETURN.

c. Wait for "The system is shut down" message to appear.

d. Turn the power circuit breaker switches (CB10, CB11, CB12) in the rear of the workstation to the OFF position.

3.6 SPECIFYING FILES

Files are specified in terms of five distinct identifiers in the following format:

DEV:[UIC]NAME.EXT;VERSION

where: DEV Device name. If DEV: is omitted from the specification, the default designation SY: is assumed. The 227X Test Set Preparation manual lists devices used on the 2275.

NOTE
Logical device names should be used for all file specifications.

[UIC] The RSX11/M Operating System requires all users to log in under a User Identification Code. The 2275 automatically performs this log-in, so that it is normally transparent to the user. There are a few cases where the user needs to be concerned with UICs. Refer to the System Manager's Guide.

NAME File name consisting of up to 9 alphanumeric characters.

EXT File extension consisting of up to 3 alphanumeric characters. Some monitor modes automatically assign the file extension if none is specified by the user.

VERSION An octal number up to 32767. The system automatically updates this number each time a new version of a file is created. When the version number is omitted, the system assumes that the highest version number file has been selected. This default to the highest number can be overridden by explicitly specifying the version number desired. For example, SY:PCBRD.TPG;6 causes the system to access version 6 of the file.

Specifying version number 0 (e.g., SC:PCBRD.TPG;0) causes the system to access the most current or highest version of the specified file.

Version numbers are a convenient way of maintaining multiple versions of a file on a disk. However, version numbers should not be relied upon to track the most current file because they could get out of sequence when moving files between devices.

In some cases there may be a need to refer to all files in a particular category. For example, all versions of the file, BOARD1, located on SC: with extension .TPG may need to be listed. Instead of specifying each file separately, use the "wild-card" character (*), which may be substituted for the version specification, to indicate all versions, as shown below:

SC:BOARD1.TPG;*

Typical application of the wild-card character (*) is in file management modes, as a substitute for any of the following file specification identifiers: UIC, filename, extension, and version. Note that the (*) cannot be used in place of the DEV identifier.

3.7 USE OF FLOPPY DISK DRIVE

The floppy disk drive is the software support device for installation of updated software and diagnostics and for archiving user programs.

3.7.1 Inserting a Floppy Disk

a. Remove the floppy disk from its protective jacket.

b. Turn the lever to remove power from the unit and allow access to the disk slot.

c. Insert the floppy disk into the slot of the floppy disk drive, so that the label is face up and the read/write slot is toward the rear of the drive.

d. Push the floppy disk all the way into the slot, and turn the lever back.

3.7.2 Removng a Floppy Disk

a. Turn the lever to remove power from the unit and allow access to the disk. Pull out the disk.

b. Return the floppy disk to its protective jacket.

3.8 MULTI-USER CONSIDERATIONS

If the test system is equipped with the Foreground/Background option (F/B), use of the system may be shared by the operator and another user. This allows board testing and program preparation to be conducted simultaneously. Power to the entire system is controlled by the POWER ON/OFF circuit breakers (CB10, CB11, CB12) on the rear panel. Therefore, the operator must not reboot (INITIALIZE) or power-down the F/B system while another operator is using the system.

3.9 COMBINATION PRINTER

The Mannesmann Tally printer used as one choice of system printer. It acts as both a printer for test diagnostic messages and as a program and report listing printer. This printer allows for the selecting of certain format characteristics. The characteristics selected by GenRad as the most appropriate are shown in Table 3-2. The operator may check to see if these characteristics are properly set by pressing the NO pad and comparing the resultant printed information with Table 3-2. Refer to the Mannesmann Tally MT160 Operator's Manual for the procedure for changing the characteristics.

Refer to the Mannesmann Tally MT160 Operator's Manual for procedures to install ribbon cartridge and to load paper.

Table 3-2
RECOMMENDED MT160 PRINT FORMAT

FORM LENGTH	6 INCH
LPI	6
CPI	12
CR IMPLIES LF	NO
LF AT FULL LINE	NO
POPC	NO
LF IMPLIES CR	NO
CHAR SET	USA
SLASH ZERO	NO
AUX CODE SET	NONE
BUFFER SIZE	MIN
INTERFACE TYPE	PARALLEL

3.10 STRIP PRINTER PAPER LOADING

WARNING

To prevent injury to personnel, power must be removed before this procedure is performed.

To load the strip printer with paper, perform the following procedure:

a. Place the POWER switch on the front of the printer to OFF.

b. Remove strip printer cover. To remove the cover, press the lower front edge and lift the cover up and back.

c. Lift the paper shaft out of the paper guide slots.

d. If necessary, remove old cardboard paper roll.

e. Insert paper shaft into new paper roll.

f. Place the ends of the paper shaft into the paper guide slots. Make sure that the paper unrolls from the bottom of the roller toward the front of the printer.

NOTE

If print head is touching the paper roller, perform steps g through i at this time. Otherwise, continue with step j.

g. Place POWER switch in the ON position.

h. Press PAPER FEED pushbutton once. The print head should no longer be touching the paper roller.

i. Return POWER switch to the OFF position.

j. Insert paper under paper roller and up between it and the print head.

k. Replace strip printer cover.

l. Place the POWER switch in the ON position.

CAUTION

The aluminum coated paper used with this printer will conduct electricity. The user must not allow it to come into contact with any exposed electrical parts of the system or the UUT.

m. Press the PAPER FEED pushbutton to ensure that the paper feeds properly. The PAPER EMPTY indicator should go out.

3.11 PRINTRONIX P300 PRINTER PREPARATION

3.11.1 Loading Paper

Locate the fanfold paper stack under the printer and in line with the loading slot near the front edge of the printer bottom. Then load the printer by performing the following steps.

a. Disable the printer by means of the ON LINE switch; then open the front cover.

b. Lift Forms Thickness Adjustment Lever to "Load" position (fully raised to move platen away from ribbon and hammer bank).

c. Insert top edge of paper through slot in printer bottom and pass it past the print station until it can be grasped by the fingers above the print station.

d. Open the tractor gate sprocket clamps on each paper tractor to expose the feed pins.

e. Pull paper up to the tractors, keeping paper vertical. If sprocket holes in paper do not match the distance between tractor feed pins, loosen knurled nuts on tractors and slide tractors sideways, as necessary, to match holes to pins; then close gate on each tractor. Position paper with the tractors so that the first character position on the paper scale falls in approximately the desired first-column position on the paper.

f. Adjust tractors to provide very slight tension across the form. Too much tension may distort sprocket holes in the paper and cause problems in paper feeding. When paper is correctly positioned and tensioned, lock knurled nuts on paper tractors. Note that the Horizontal Vernier may be adjusted at any time to position the first character at the correct location in the form (within a 3-character range).

g. If power is off, turn on the power to the printer; then press TOP OF FORM pushbutton.

h. Use the Vertical Forms Positioner Knob to set the space for the first printing line opposite the TOP OF FORM mark on the left-hand tractor.

i. Align reference mark on the Vertical Forms Positioner Disk with the fixed pointer; rotate the Vertical Forms Positioner Knob exactly one revolution to lower the paper. Leave the paper reference mark aligned with the fixed pointer. This locates the top-of-form line on the paper at the print station.

j. Grasp the paper at both sides below the paper entrance and pull lightly downwards to make the paper taut in the printer.

k. Move the Forms Thickness Adjustment Lever downwards to the position suitable for the paper or form in the printer. Position depends on the number of parts or paper weight, e.g., set to position 3 for 3-part forms, etc. CHECK indicator should be OFF.

NOTE

If the Forms Thickness Adjustment Lever is not positioned correctly, data may not be printed.

This completes paper loading. Prepare printer for on-line operation by pressing the ON LINE button.

3.11.2 Changing Ribbon

To change the ribbon, proceed as follows:

a. Disable the printer by means of the ON LINE switch, then open the front cover.

b. Remove paper from printer.

c. Unlock both ribbon spools by pulling latches toward center of hubs, and then lift spools from hubs, clearing loose ribbon from the guides and ribbon slot. Discard used ribbon and spools.

d. Check for any build-up of ribbon chaff around guides and clean if necessary, wiping with a soft cloth.

e. Install new ribbon spools on the hubs, with ribbon running off the spools as shown in the decal on the ribbon assembly.

f. Run ribbon over the ribbon guides and across the front of the shuttle as shown in the decal on the ribbon assembly.

g. Rotate either spool to take up slack, and make sure the ribbon runs smoothly over the guides. A twisted ribbon will cause missing characters, shorten ribbon life, and create paper jams.

h. The new ribbon is now ready for use, after paper is loaded and the Forms Thickness Adjustment Lever is set to the correct position.

NOTE

Ribbon life will be extended if ribbons are inverted periodically.

Production Test Operation — Section 4

4.1 INTRODUCTION

The workstation operator is responsible for the actual testing of printed-circuit boards. This section contains instructions for performing the various functions required for this testing.

The procedures assume the following conditions exist.

Operator instructions are available for board.

System is initialized (Diagnose options page is visible). See Start-up procedure in Section 3 if not.

Test program for board is installed in system or operator instructions give procedure for installing it.

Fixture is available to operator.

Operator is familiar with controls and indicators described in Section 2.

Operator is familiar with Monitor operation described in Section 3.

The first activity for an operator when starting a new test run for a particular board type, is to read the operator instructions. This will tell the operator how to start the test run. There are various methods for starting the test run. The method used is determined by the test set preparer, who makes sure that the test program, test fixture, and operator instructions are coordinated. The operator instructions will also contain information the operator will need during testing.

The basic steps performed in starting and proceeding through a test run are:

a. Mount fixture on workstation.

b. Select options on Diagnose options page and/or issue commands as instructed by operator instructions. If a dual fixture is used, select split fixture option on lower level page.

c. Place pc board on fixture.

d. Run test and respond to prompted actions.

e. Remove pc board, attach diagnostic report if necessary, and expedite as required.

f. Repeat c through e until run is completed.

g. Return control to Diagnose page for next run.

The significance of these steps, for the operator, varies with the method of testing described in the operator instructions. Figure 4-1 illustrates the flow of some typical methods of running tests. Procedures for the individual steps and methods are provided in para 4.2.

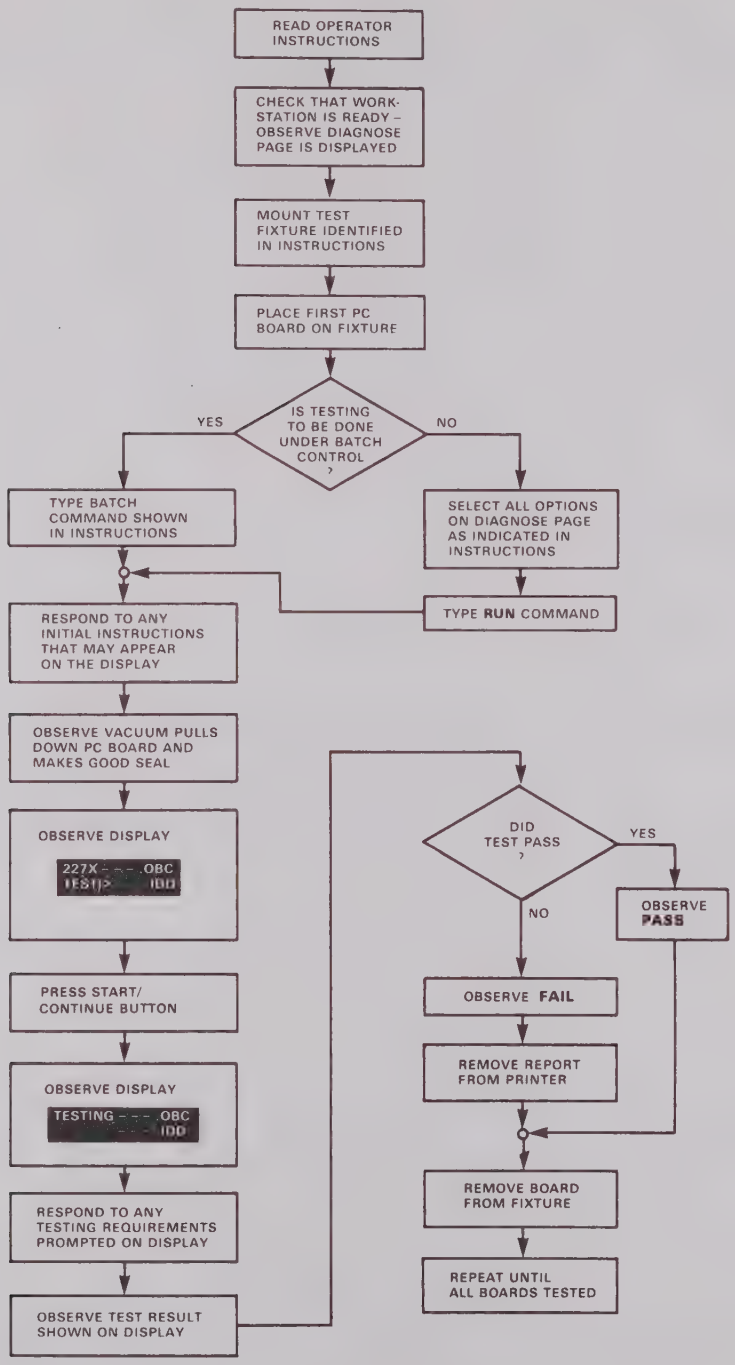
READ OPERATOR INSTRUCTIONS
CHECK THAT WORK-STATION IS READY – OBSERVE DIAGNOSE PAGE IS DISPLAYED
MOUNT TEST FIXTURE IDENTIFIED IN INSTRUCTIONS
PLACE FIRST PC BOARD ON FIXTURE
IS TESTING TO BE DONE UNDER BATCH CONTROL ?
YES
NO
TYPE BATCH COMMAND SHOWN IN INSTRUCTIONS
SELECT ALL OPTIONS ON DIAGNOSE PAGE AS INDICATED IN INSTRUCTIONS
TYPE RUN COMMAND
RESPOND TO ANY INITIAL INSTRUCTIONS THAT MAY APPEAR ON THE DISPLAY
OBSERVE VACUUM PULLS DOWN PC BOARD AND MAKES GOOD SEAL
OBSERVE DISPLAY
227X - - - .OBC
(TEST)> IDD
PRESS START/ CONTINUE BUTTON
OBSERVE DISPLAY
TESTING - - - .OBC
IDD
RESPOND TO ANY TESTING REQUIREMENTS PROMPTED ON DISPLAY
OBSERVE TEST RESULT SHOWN ON DISPLAY
DID TEST PASS ?
YES
NO
OBSERVE PASS
OBSERVE FAIL
REMOVE REPORT FROM PRINTER
REMOVE BOARD FROM FIXTURE
REPEAT UNTIL ALL BOARDS TESTED

Figure 4-1. Typical Testing Flow.

4.2 BOARD TESTING PROCEDURES

4.2.1 Mounting Test Fixture

The test fixture is the bed-of-nails fixture which mounts on the test shelf. The nails that contact the unit-under-test (UUT) are connected to the test system through the receiver interface on the test shelf (see Figure 4-2). Inlet ports provide the vacuum to the test fixture which draws the UUT down to contact the nails. If the correct test fixture is already in place, then proceed to the instructions for placing a board on the fixture, para 4.2.2.

Mount a test fixture as follows:

a. Using test set documentation and control procedures in place at your facility, locate the proper fixture for the board to be tested.

b. If another fixture is mounted, turn all the ZIF connector levers to the released position, starting at connector on the right. Grasp the fixture with both hands so that your thumbs are pressing down on the release buttons. Pull the test fixture away from the receiver unit. If no fixture is mounted, be sure that all ZIF connectors are released.

c. Place the fixture shown in Figure 4-3 on the test shelf, and grasp it with both hands so that your thumbs are pressing down on the release buttons. Make sure the fixture is lined up with the guides and push it so that the edge connectors on the back of the fixture fully mate with the ZIF connectors.

d. Close each ZIF connector lever.

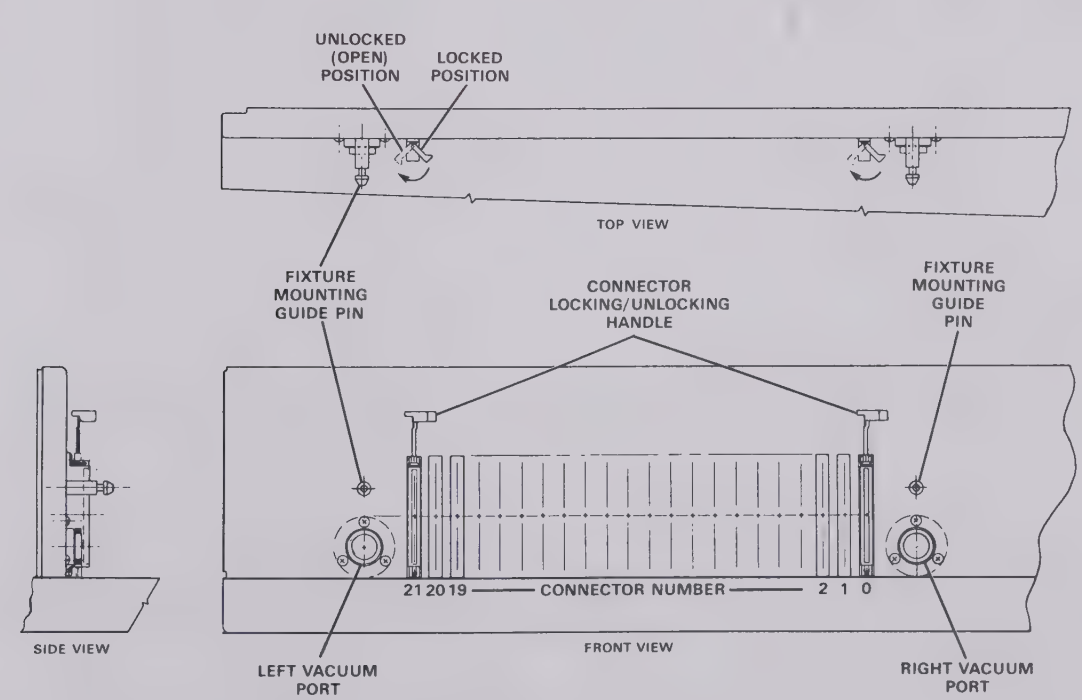

Figure 4-2. Test Fixture Receiver Interface.

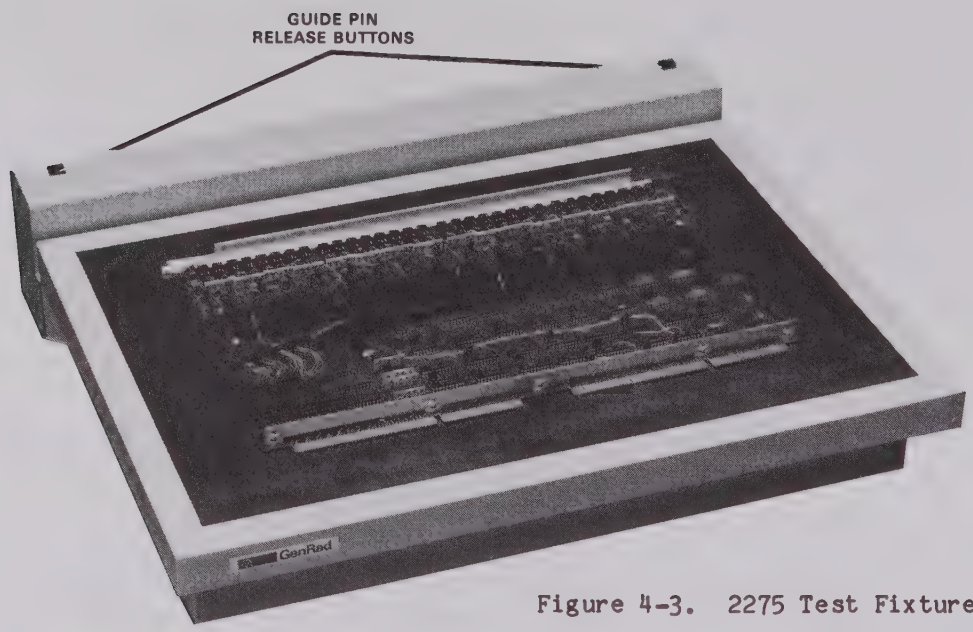

Figure 4-3. 2275 Test Fixture.

Test Fixture Maintenance

Bed-of-nails fixtures, particularly those used extensively, must be maintained to provide continued good performance. The following preventive maintenance procedures are recommended.

a. Contact pins, especially those with a serrated or flat contact surface, are prone to a build-up of compacted flux and dirt particles after being in use for some time. If a build-up is noticed, loosen it, using a stiff-bristled brush, then vacuum the bed-of-nails to remove loose dirt.

NOTE

A brush with non-metallic bristles is recommended. Do not use solvents to clean contact pins, as they will wash away the lubricants from the contact pin plunger-and-barrel assembly and may carry dirt into the contact pin barrel.

b. Keep the rubber diaphragm of the test fixture free of dust and foreign particles by vacuuming when necessary.

4.2.2 Placing Board on Fixture

When the proper test fixture is mounted on the test shelf, a pc board can be placed on it.

Mount a pc board as follows:

a. Position the board on the bed-of-nails fixture, being careful to line up the tooling holes on the board with the locating pins on the fixture. The locating pins ensure a good vacuum seal between the edges of the board and the rubber sealing strips on the fixture and cause the nails to be located under the proper board test nodes.

b. Push the AUTO button on the front panel (Figure 4-4), located above the receiver unit, to enable the vacuum to be turned on automatically by the test program. Use the right-side vacuum control AUTO button for single-board test fixtures; use both the right and left AUTO buttons when split-fixturing (two beds-of-nails on a single test fixture) is used.

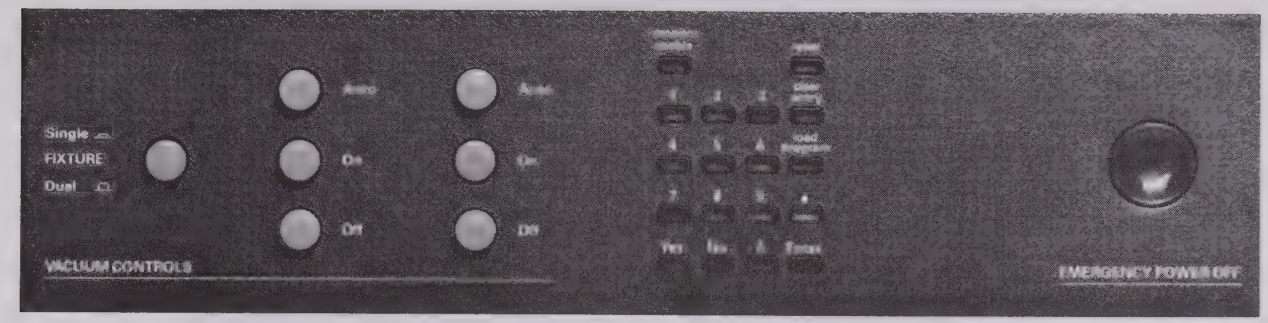

Figure 4-4. Front-Panel Vacuum Controls and Keypad.

4.2.3 Using the Keypad, START Button, and Keyboard

Test procedures can be designed to allow all steps of a test run to be controlled from the front-panel keypad shown in Figure 4-4 and the START pushbutton. There are 2 conditions where the keypad can be used to start a test run:

1. When a batch file is used and the batch file name is numeric.

2. When the test run is for the same board as the previous run with no change in options.

Once a test run is started, the START button is used to continue testing boards, the only restrictions being that the changing of options and the issuing of commands, such as INFO and ERASE, must be done on the keyboard. The keyboard must be attached to the system when the test operator is required to select options or when a batch file is not used for starting a test run.

Either START button is used with single-board fixtures. Split-fixturing requires the 2 buttons to control testing independently on the left and right sides of the test fixture.

4.2.4 Select Test Program and Options

When the system is initialized (refer to Section 3 for start-up procedure), the Diagnose options page (Figure 4-5) appears on the display and is ready to accept a command, as discussed in this paragraph.

The procedure for specifying test programs and selecting test options is a function of each user site testing requirements. Therefore, test operator instructions should be prepared by each system manager and/or test set preparer. A few typical procedures are illustrated in the remainder of this paragraph and in Appendix B under the following headings:

Testing Under Batch Control
Testing With Dual Fixture
Testing with a LOAD routine
Testing Using TRACS (Appendix B)

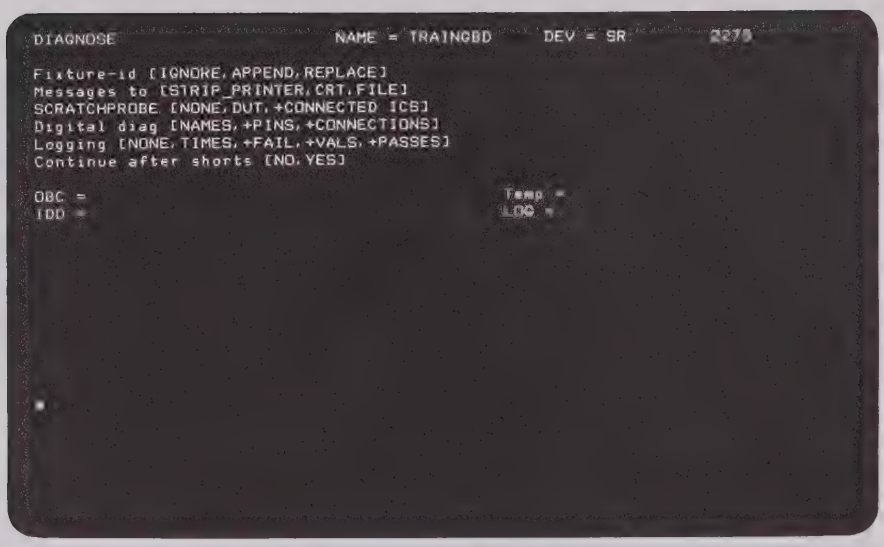

Figure 4-5. Diagnose Options Page with LIMITed Monitor Access Enabled.

Test operator instructions should indicate what options are to be selected on the Diagnose page unless a batch file is used to start the test run. A full description of the purpose for each option is given in para 4.5. The method of selecting options is given in para 3.2.

Testing Under Batch Control

The batch feature provides a means of starting a test run with a minimum of operator action. It also provides for selecting options that would otherwise be inaccessible from LIMITed monitor operation.

There are several methods for calling batch operation. The applicable method would be indicated in the instructions issued by the system manager, test supervisor, or equivalent individual.

One method is:

a. Observe that system is ready (Diagnose page shown in Figure 4-5 is on display) and mount test fixture and first board of test run.

b. Type the batch command

#. .

to start testing. This command assumes that the fixture-ID agrees with the file name of the test program and that the device where the test program is stored is currently the default device indicated at the top of the monitor page.

c. The system responds by finding and executing the batch file whose name is the same as the fixture-ID and whose extension is .BCH. The batch file must contain the commands necessary to fill out the options on the Diagnose page. It also contains the RUN command which causes the test program to be loaded. The test prompt (Figure 4-6) appears when the test program is loaded.

d. Testing can continue as described in para 4.2.5.

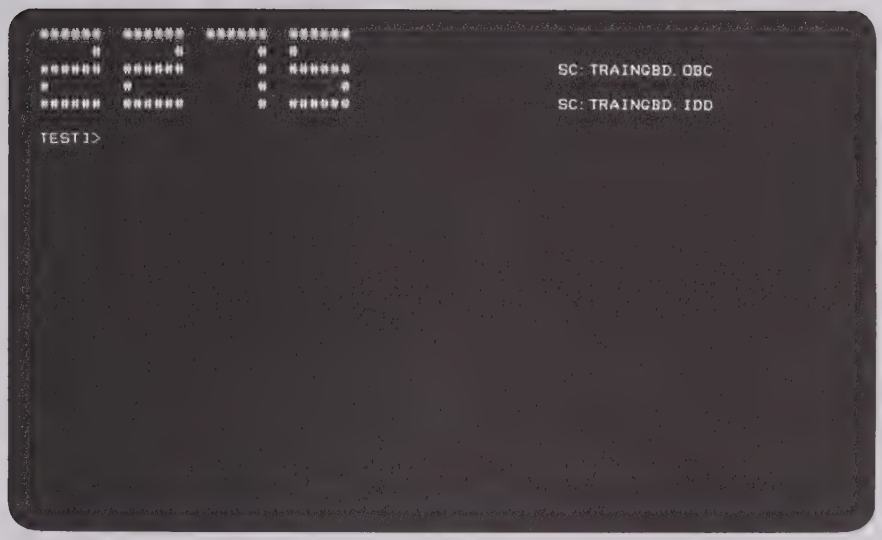

Figure 4-6. Lower-Level Monitor Display.

In the above method the operator only needs to know what fixture to mount in order to start the test run.

In another method, a batch job can be started from the command mode by typing a period (.) as the first character on the line. The complete defaulted file specification for the batch input file called with just a period is the "DEV =" and "NAME =" entries, from the top of the Diagnose options page, with the extension .BCH. Thus, the command

#.

directs the system to attempt to locate and run the batch job:

default-device:default-filename.BCH

In the third method, a file name may be specifically included in the batch job call to override the default. Remember, if the batch job is to be run using the keypad, the alternate name must be comprised of numerals only. A period followed by a name directs the system to locate and run that batch file. For example:

#.1731

instructs the system to find the file:

SC:1731.BCH

(assuming the "DEV =" option at the top of the page is SC:).

Testing with Dual Fixtures

Small pc boards may be tested by designing the test program and test fixture so that two boards can be mounted on the fixture at the same time. The procedure would include the following steps:

a. Observe that the system is ready.

b. Mount the test fixture.

c. Place a board on each side of the fixture.

d. Move cursor to "NAME =" option and type in board name.

e. Move cursor to "DEV =" option and type in device name.

f. Type RUN command.

g. Press the HELP key to display the lower-level Diagnose options page. See Figure 4-15.

h. Type: Split Fixture = YES.

i. Type: Offset for Split Fixture = n, where n is the offset pin number that is provided with the test set instructions to the test operator.

j. Press the left START button. The left board will be pulled down and tested. When the test is complete, the left board will be released. The system will then wait for operator action.

k. Take the appropriate actions described in paras 4.2.5 through 4.2.7.

l. Press the right START button. The right board will be pulled down and tested. When the test is complete, the right board will be released. The system will then wait for operator action.

m. Take the appropriate actions described in paras 4.2.5 through 4.2.7.

n. Remove both boards from the fixture and place two more boards on it.

o. Repeat steps j through n.

Testing with a LOAD Routine

The test program may do different tests, depending upon information provided by the operator at the beginning of a test run. A routine (called a LOAD routine) in the test program, which is automatically executed only when the program is loaded, could display a message that requires an operator response. A typical LOAD routine could be written to prompt the operator for the version of the board being tested. This would be important if the test program were written to execute differently for the various board versions.

a. Observe system is ready (Diagnose page is on display).

b. Move cursor to "NAME =" option and type in the board name.

c. Move cursor to "DEV =" option and type in the device name.

d. Type RUN command.

e. The LOAD routine message may be displayed:

What version is the pc board?

f. Type in the version.

g. The LOAD routine is complete. The test prompt shown in Figure 4-6 appears and the test run can continue as described in para 4.2.5.

4.2.5 Continue Test Run

After the test program has been loaded and a pc board placed on the fixture, run the test by pressing the START pushbutton. Before the testing begins, vacuum will be applied to the test fixture, drawing the UUT down to contact the bed-of-nails pins. If the system cannot establish electrical contact with the UUT within approximately 3 seconds, the attempt to run the program ceases and a time-out message is displayed. Once the UUT has been pulled down and contact with the system established, the test system will begin to measure analog components and exercise digital components on the board. When testing begins, the display in Figure 4-7 appears on the screen.

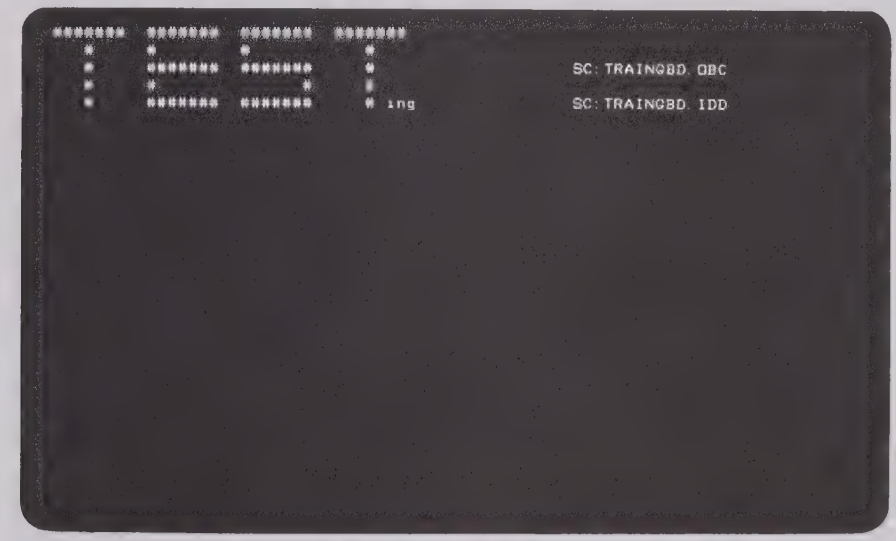

Figure 4-7. Testing-In-Progress Display.

The result of the test is displayed on the screen. The result is either that the UUT passes all the tests in the test program and is determined to be free of faults or that faults in the UUT have been detected and the UUT fails the test. Figure 4-8 is the display for a passing board, Figure 4-9 the display for a failing board. If the UUT passes, continue with para 4.2.6; if it fails, continue with para 4.2.7.

Test each pc board with the following sequence of steps.

a. Press the START button to begin the test.

b. Carry out any instructions which the system may write on the video display (refer to the next paragraph on probing).

c. Follow the procedures for either PASSing boards or FAILing boards, depending on the result of the test.

d. For all the boards to be tested, repeat the steps, beginning with step a, para 4.2.2.

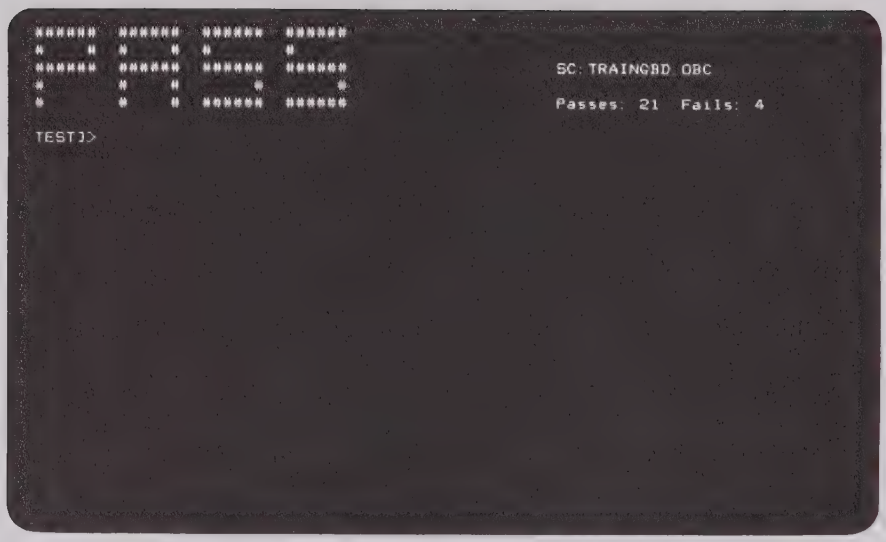

Figure 4-8. Passing (Good) Board Display.

Figure 4-9. Failing (Faulty) Board Display.

Directed Probing

If the SCRATCHPROBE option is enabled and a digital component fails a test, the system directs the operator to probe specified nodes and components on the pc board to aid in diagnosing the cause of the failure. Probing (when enabled) is the last step in testing and automatically displays a figure representing the first failed IC; see Figure 4-10. If the system suspects a faulty contact between the driver/sensor nails and the UUT, it will direct the operator to use the SCRATCHPROBING diagnostic technique to determine if its suspicions are correct. To conduct probing, the .IDD file must be present for the system to direct the operator to the nodes to be probed. VCC and GND are not probed during directed probing.

The SCRATCHPROBE option selects the level of probing for the UUT. Selecting NONE specifies no probing of digital ICs. Specifying DUT directs the operator to probe those digital ICs that have failed, in order to determine if

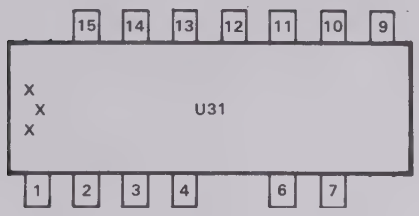

Figure 4-10.
Initial Probing Display.

an open connection between the IC pins and the system driver/sensors may be causing the apparent failure. +CONNECTED ICS directs the search beyond the failed IC in an attempt to discover the location of the actual failure. The system directs the operator to check other IC pins connected to the same test pin. If no continuity exists between any IC pin and the test pin, the following message is issued:

*** No contact between track and nail
probable fixture problem

If there is continuity to at least one IC pin, the following message appears:

*** Track or Pin Open

When a failing IC is encountered, an outline representing the failing IC appears on the screen, with all connected pins of the IC shown outside of the figure in reverse video (Figure 4-10). The operator gently sweeps (scratches) the probe across all the pins of the indicated IC. As continuity is detected for each pin, that pin number moves from outside to inside the IC outline (Figure 4-11). When full continuity is verified, the probing display disappears from the screen. If the system finds continuity for all the pins, it can be assumed that the IC itself is defective.

In the case of 2 or more pins on an IC having connections to the same driver/sensor, the system automatically directs the operator to probe those pins again to verify the continuity of each pin to the D/S nail individually. If continuity is found for all the pins in the first IC figure, the figure will appear a second time, displaying only those pins with more than one connection. If full continuity is not obtained on the first IC figure, pressing the START button will cause the second display to appear. As with the first figure, connected pins are initially shown in reverse video outside the IC figure and, as continuity is verified to each pin, that pin number is moved inside the figure.

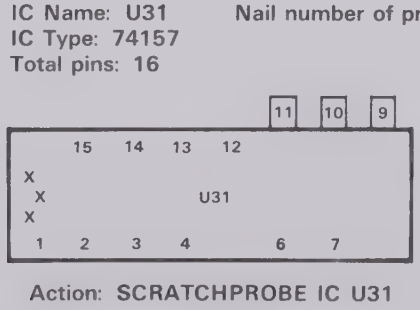

Figure 4-11.
Partial Continuity Display.

If, after probing all the IC pins, the figure remains on the screen with pin numbers still outside the outline, this indicates there is an open connection (either an open track or bad nail) to that component pin. To continue probing other components on the UUT, press the START button, which causes a diagnostic report for the failed IC to be printed on the strip printer and displays the next IC outline on the screen, ready for probing in the same manner as described in the preceding paragraphs.

NOTE

While the SCRATCHPROBING technique is being used, power is not applied to the unit-under-test.

4.2.6 PASSing boards

If no faults are found and the pc board passes, the system will display the PASS message on the screen (Figure 4-8). Remove the pc board from the test fixture and place it with the tested-good boards.

4.2.7 FAILing boards

A UUT may fail testing for one or more of several reasons. Some typical faults that cause a pc board to fail circuit-board testing include:

1. Shorts and opens between etches and components.

2. Missing or incorrectly inserted components (analog and digital).

3. Analog components (resistors, capacitors, inductors, etc) non-functional or out-of-tolerance.

4. Digital components (ICs) not functioning properly (logical errors, e.g., improper output-pin states for given input-pin states).

When a UUT fails a test, the operator is alerted by a FAIL message (Figure 4-9) on the video display. The system may have directed the operator to probe the UUT before issuing the FAIL message. If the STRIP_PRINTER selection is enabled in the Messages to option, the report will be printed on the strip printer in the format illustrated in Figure 4-12. The fault (or multiple faults) and the causes are printed in a diagnostic report. This report identifies the detected faults to assist in repairing the board.

```
R100
  EXPECTED          ACTUAL
 10K OHMS         416.1K OHMS
 LIMITS ARE 8.971K AND 11.04K OHMS
** Shorted Nails **
21,77;

  Nail          (Component.Pin)


  21      Node: N21
        (Q2.D)  (R100.3)  (R15.1)
        (U6.7)

     77  Node: N77
        (R13.2)  (R14.1)  (U6.6)

13-OCT-83  15:56:23

 BOARD 4715 FAILED
```

Figure 4-12.
Failed UUT Diagnostic Report.

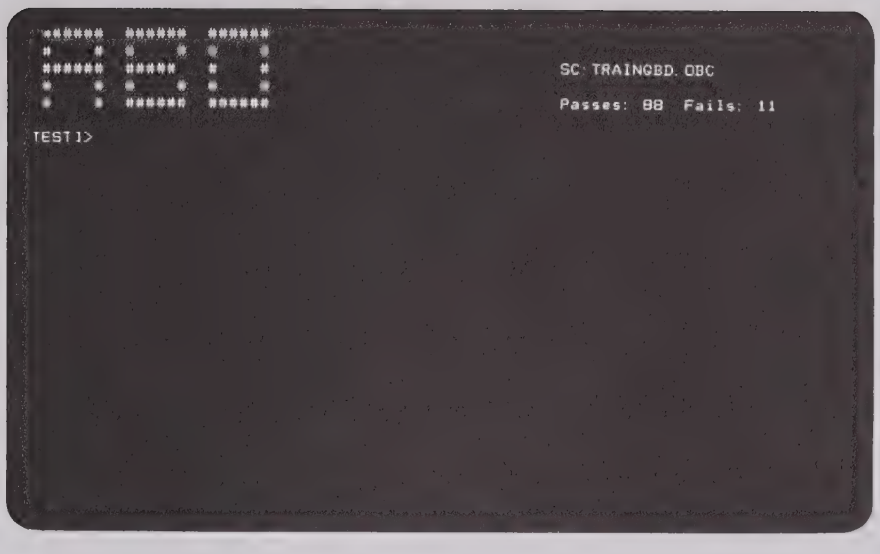

Figure 4-13. ABORTed Test Display.

The following sequence of steps is suggested when a FAILing board is encountered:

a. Remove the diagnostic report from the strip printer.

b. Attach the report to the faulty pc board.

c. Return the board, with report attached, for repair.

4.3 ABORTING A TEST

The operator can abort a test run while it is in progress by pressing the CTRL C keys simultaneously. The page shown in Figure 4-13 appears on the video display when a test has been aborted. Aborting a test run stops any further testing of the UUT and resets the system to the beginning of the test program. The operator can then retest the current UUT (after correcting problems which made aborting the test necessary), reject the current UUT and resume testing with the next UUT, or discontinue the testing run by pressing the CRTL C keys a second time, which returns control to the top-level Diagnose page.

If the logging option is enabled, aborting the test run causes the system to query the operator:

Do you wish to cancel the last board's logging data? [Y/N]:

Responding Y cancels the logging data, but an entry indicating that a test was aborted is recorded in the logging file.

4.4 EMERGENCY POWER-DOWN

During normal operation the test system poses no safety hazard to an operator and is internally protected against damage. However, the operator may have to power-down the system quickly should a serious system malfunction occur.

To shut down the system, quickly and safely, in the event of a potentially harmful condition, push the EMERGENCY POWER OFF button, located on the front panel.

NOTE

Do not use the EMERGENCY POWER OFF pushbutton for normal shutdowns. This pushbutton is available in the event of a test system catastrophe; however, if it is pressed while active tasks are being performed, loss of data is probable, and a user may have to reload the system software.

CAUTION

After an emergency shut-down, DO NOT RESTART the system until it has been thoroughly checked and, if necessary, repaired.

4.5 DIAGNOSE MODE OPTIONS

4.5.1 Diagnose Page

The Diagnose options page is used to run a test program in one of three modes: testing a pc board, testing with TRACS analysis, or debugging a test program. The choice can be made from the unlimited access level of the monitor by selecting the appropriate choice in the Mode option on the Diagnose page (Figure 4-14). The limited Diagnose page of para 4.2.4 did not have this option. Refer to the Test Set Preparation manual for details on entering unlimited or limited monitor operation.

Figure 4-14. Diagnose Options Page (Unlimited Monitor in TEST mode).

When the TEST sub-mode is selected in the unlimited monitor, the operation of Diagnose mode becomes identical to the limited Diagnose mode. A more detailed description of the diagnose options is given in this paragraph.

Mode [TEST,TRACS,DEBUG]

[TEST] Refer to para 4.2.4.

[TRACS] Refer to Appendix B.

[DEBUG] Refer to the Test Set Preparation manual.

Fixture-id [IGNORE,APPEND,REPLACE]

When test fixtures with wired ID-codes are used, the name of the test program files can be specified or modified by this option. The name can default to the "NAME =" entry, the decimal number equivalent of the wired binary-coded fixture-ID, or a combination of the two.

[IGNORE] Instructs the system to use only the entry to the "NAME =" option as the file name.

[APPEND] Directs the system to read the 16-bit ID-code from the fixture in addition to the entry in the "NAME =" option. The ID-code is converted to a decimal number which is appended to the "NAME =" entry.

[REPLACE] Causes the system to read the ID-code and use the decimal number as the name for the test programs, replacing any entry in the "NAME =" option.

Examples

Assuming the name SAMPLE is filled-in to the "NAME =" option and the fixture-ID is wired to 0000000110110010 (decimal 434), the names resulting from each of the selections are as follows:

IGNORE uses only the "NAME =" entry: SAMPLE
APPEND adds fixture-ID to "NAME =" entry: SAMPLE434
REPLACE uses only fixture-ID: 434

NOTE

Leading zeroes in the fixture-ID are suppressed.
The file name can have a maximum of 9 characters.

Messages to [STRIP_PRINTER,CRT,FILE]

Specifies the device to which diagnose error and status messages will be sent. Messages may be sent to the strip printer (default), displayed on the monitor's video display, or stored on a disk as part of the .MES file.

[STRIP_PRINTER] The default setting, prints messages on the strip printer.

[CRT] The diagnose error and status messages appear on the system's video display instead of being printed on the strip printer. No permanent copy of messages is made when Messages to [CRT] is specified.

[FILE] Causes error and status messages to be written to a disk file instead of displaying them on the printer or video display. The message file can then be viewed at a later time. Refer to the "MES =" file spec option for additional information about Messages to [FILE].

SCRATCHPROBE [NONE,DUT,+CONNECTED ICS]

Selects the level of diagnostic probing that should be conducted on the UUT.

[NONE] Indicates to the system that no probing is to be done.

[DUT] Instructs the system to direct the user to probe only those digital ICs that have failed, in order to determine if an open between the IC pins and the system driver/sensors may be causing an apparent failure.

[+CONNECTED ICS] Directs the search beyond just the failed IC in an attempt to discover the location of the actual failure.

Digital diag [NAMES,+PINS,+CONNECTIONS]

The digital diagnostic report provides the user with information on the digital ICs that failed during digital testing. In general, if the SCRATCHPROBE option is not enabled, each IC failure is reported as it occurs (i.e., at the end of the burst in which it occurred). If the SCRATCHPROBE option is enabled, however, the report is delayed until after the failed ICs have been probed. This allows the system to determine if an open pin might be the cause of the apparent failure and, if so, to ignore the burst results.

[NAMES] Includes the failing IC name and type in the report.

[+PINS] The IC name and type, plus failing pin(s) and pin type(s), are included in the report.

[+CONNECTIONS] Adds connections to other ICs to the already included IC and pin data in the report.

Logging [NONE,TIMES,+FAIL,+VALS,+PASSES]

Logging of test data is done while normal testing operations are being performed. Logging does not interfere with or change standard testing procedures. This option allows the user to determine what test data are written to the .LOG file. When any selection except NONE is enabled, the "LOG =" file spec option appears on the page. Information from the .LOG files is analyzed and reported by the Log (Report Generator) mode.

[NONE] No logging is done and no LOG file is created.

[TIMES] Includes in the .LOG file the times at which program load, unload, start, stop, cancel, and abort operations are performed. These entries are referred to as time stamps.

[+FAIL] In addition to the time stamps, labels and keys for each failed component will be included in the .LOG file.

[+VALS] The measured values of each failed component are included in the .LOG file along with the time stamps, labels, and keys.

[+PASSES] All previous logging data, in addition to the results from passing as well as failing components, are included in the .LOG file.

NOTE

Section 5 (Report Generator) describes the options for processing and formatting these logged data.

Continue after shorts [NO,YES]

This option provides the ability to continue with the digital portion of a test program even after aborting analog tests due to a detected short.

[NO] Selecting NO causes the system to stop testing after finding any shorts on the UUT.

[YES] Selecting YES allows the digital components on the UUT to be tested even if the analog tests are aborted due to the presence of shorts. Any ICs connected to the nodes that failed the shorts test, however, are not tested.

OBC =
The file specification for the translated test program (.OBC) file. The specification defaults to the device and name from the top of the page and the extension .OBC. An entry is needed only if the test program file spec is different from the default.

IDD =
The file specification for the In-circuit Diagnostic Data (.IDD) file. The specification defaults to the "DEV =" and "NAME =" entries and the extension .IDD. An entry is needed only if the file specification differs from the assumed default.

Temp =
Assigns the disk-device to store the temporary files created by a TEST run. Defaults to the "DEV =" device if no entry is made here.

LOG =
The user can supply an alternate file specification for the data logging (.LOG) file. The specification defaults to the device and name from the top of the page and the extension .LOG. This option only appears if the Logging option is set to anything but NONE.

MES =
This file spec option appears on the page when Messages to [FILE] is enabled. The default is the "DEV =" and "NAME =" entries and the extension .MES. An alternate device, name, and/or extension can be assigned here. The message file includes the results of the shorts and opens tests and the results of analog and digital testing.

NOTE
When messages are written to a file no immediate visual diagnostic report appears on the printer or video display during testing.

4.5.2 Test Mode Options

The lower-level monitor page contains several additional options that may have to be set to operate the tester. Press the HELP key to display the full lower-level options page shown in Figure 4-15.

The additional options that appear on the lower-level monitor page, and which apply to Test mode, are:

Number of Probe nail =
Specifies the nail to which the probe is connected. If no number is assigned by this option, the system automatically reads the probe nail number from the .IDD file.

Sync Pulse nail =
Specifies the nail to which the external sync pulse connector is connected. This option is only valid on test systems equipped with the clock generator board. The system automatically reads the sync pulse nail number from the .IDD file if no number is assigned by this option.

Split Fixture enabled [NO,YES]
Specifies whether or not the test program and fixture are designed for split fixture (two beds-of-nails on a single test fixture) use.

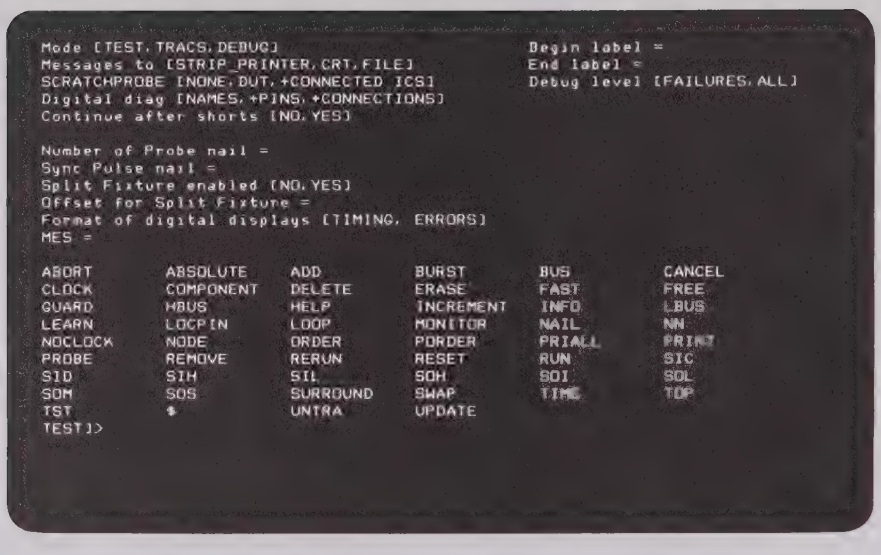
Mode [TEST,TRACS,DEBUG]
Messages to [STRIP_PRINTER,CRT,FILE]
SCRATCHPROBE [NONE,DUT,+CONNECTED ICS]
Digital diag [NAMES,+PINS,+CONNECTIONS]
Continue after shorts [NO,YES]
Number of Probe nail =
Sync Pulse nail =
Split Fixture enabled [NO,YES]
Offset for Split Fixture =
Format of digital displays [TIMING, ERRORS]
MES =
Begin label =
End label =
Debug level [FAILURES,ALL]
ABORT ABSOLUTE ADD BURST BUS CANCEL
CLOCK COMPONENT DELETE ERASE FAST FREE
GUARD HBUS HELP INCREMENT INFO LBUS
LEARN LOCPIN LOOP MONITOR NAIL NN
NOCLOCK NODE ORDER PORDER PRIALL PRINT
PROBE REMOVE RERUN RESET RUN SIC
SID SIH SIL SOH SOI SOL
SOM SOS SURROUND SWAP TIME TOP
TST $ UNTRA UPDATE
TEST]>

Figure 4-15. Lower-Level Monitor Options Page (Full Display).

Offset for split fixture =

If a split fixture is used, then the number of scanner or D/S pins that separate the two fixtures must be specified. This number must be a multiple of 16. Specifying 0 indicates that the two fixtures are designed to be wired to the same set of scanner or D/S pins.

Format of digital displays [TIMING,ERRORS]

This option applies to debugging only and is not needed for board testing.

MES=

If "Messages to FILE" is enabled on the top-level Diagnose page or the lower-level options page, this file specification line appears on the lower-level display. The device and name default to the "DEV =" and "NAME =" entries from the Diagnose page and the extension defaults to .MES.

Suppress messages [NO,YES]

This option applies only to TRACS mode, which is discussed in Appendix B.

Begin label =
End label =
Debug level [FAILURES,ALL]

These options do not apply to the Test sub-mode; they are for Debug sub-mode operation which is discussed in the Test Set Preparation manual.

The following commands, shown in the list at the bottom of the page, are useful in Test mode.

INFO Directs entries made on the keyboard to the strip-printer or a file. Messages and notes may be added to diagnostic reports on the printer by entering INFO, typing the message, and pressing CTRL Z to leave INFO. Messages may be written to a file by including a file specification in the command, e.g.:

```
TEST]> INFO SY:MESSAGE.TXT
```

writes entries from the keyboard to the file SY:MESSAGE.TXT. While INFO is enabled, all entries except CTRL Z are sent to the printer or file; therefore, monitor commands entered in INFO are not executed by the system.

ERASE Clears the entire screen, leaving only the TEST]> prompt on a line near the top of the page. After ERASE has cleared the screen, pressing the HELP key will display the full lower-level options page.

MONITOR Returns system control to the top-level monitor and displays the Diagnose mode options page.

The remaining commands shown at the bottom of the page are used only in Debug mode and are explained in the Test Set Preparation manual.

4.6 BATCH UTILITY

To use the Batch utility, type BATCH (abbreviated B) from any monitor page and press RETURN. The options page shown in Figure 4-16 will appear on the screen.

Figure 4-16. Batch Utility Options Page.

BCH =
The default file spec assumed for the batch input file is "DEV =" and "NAME =" options from the top of the page and the extension .BCH. Any part or all of the default file spec can be changed by specifying the alternate device, name, and/or extension in this option.

BLI =
The default file spec assumed for the batch listing file is "DEV =" and "NAME =" options from the top of the page and the extension .BLI. Any part or all of the default file spec can be changed by specifying the alternate device, name, and/or extension in this option.

Example Enter .BCHJOB from any monitor page. The initial period tells the system to run the file with the following name as a batch job; the commands in BCHJOB.BCH are executed and error messages are written to the file BCHJOB.BLI (as well as to the terminal).

Using the Report Generator– Section 5

5.1 INTRODUCTION

Data logging and report generation provide a 2-step process consisting of the collection of data at the time a board is tested and the sorting of collected data into concise reports.

Information can be logged during testing by selecting a Logging option on the Diagnose monitor page. (Refer to Section 4 for a description of the Diagnose page and this option and to paragraph 5.2 for a description of the logging format.) The option chosen determines the type of information that will be collected as each board is tested; this information can include:

- Name of board (UUT)
- Start and stop times (referred to as time stamps)
- Pass/Fail indications
- Shorts/Opens failures
- Component names/types and internal part numbers
- Component measured values
- Test limits
- Test type

These data are written out during testing (Diagnose mode) to an ASCII file with the default extension .LOG. Later, Log mode can be used to produce a statistical report file (default extension .REP). This report is an ASCII file that can be listed on the printer. The report can present the following information:

- Yields of passing and failing boards
- Total elapsed times, consisting of total testing times and total waiting times
- Average board-test times, including actual time, passing-board test time, and failing-board test time
- Throughput into and out from the tester, giving good-board or repair inventory
- Failure data on the most frequently failing components
- All component failures sorted by frequency or component name
- A plot of measured component values, showing the distribution of measurements

The type of report is selected by monitor options in the Log (Report Generator) mode options page described in para 5.3.7.

A report can be in the form of a failure analysis of logged data or of data that were previously summarized. The report can also be in the form of a trend analysis in which data (either logged or summarized) are analyzed and compared to other data. A feature for both reports and trend-analyses is a reference mark (!!!), with a footnote at the bottom of the page indicating that the trend for this entry deviates significantly from the summary for this item.

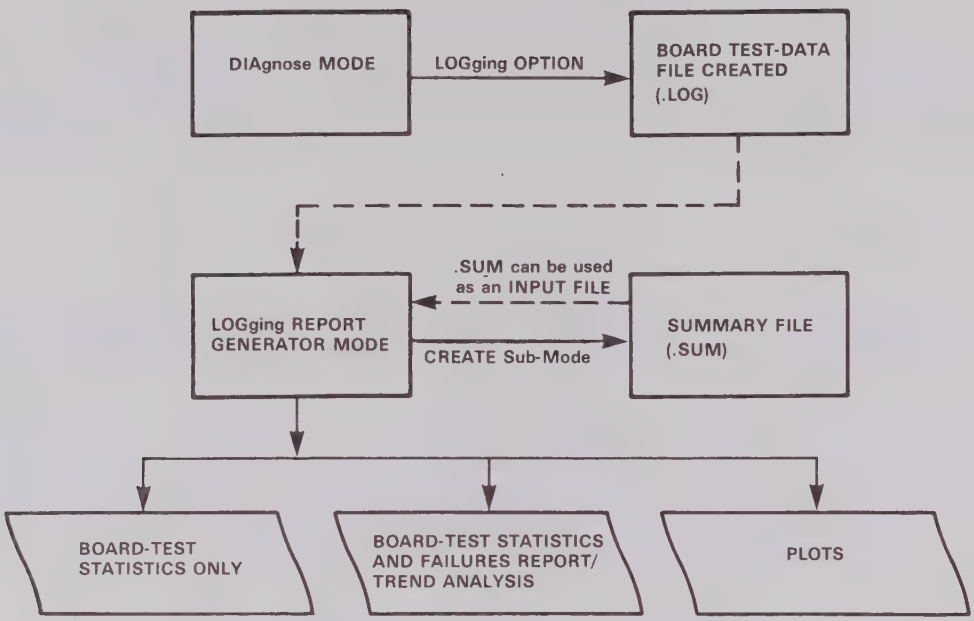

Figure 5-1. Data Logging and Report Generation.

Another report feature is the capability of time-delineated reporting. The start and stop times are automatically recorded for each test in the log file when testing is performed. A time "window" can be specified in the Log mode to restrict the reporting between 2 specified times. Figure 5-1 illustrates the modes and major mode options in the collection and report process. Note that the Diagnose mode page is used to specify only the data-collection options. The output report options are specified in a different mode, the Log mode.

Depending on the options specified in the Log mode, a report can be made to present the data, or a summary file can be made. A report can be listed by itself and is referred to as a failure data report, or the logged data can be presented as a trend analysis where they are compared to other data contained in one or more files. If a summary file is made, a report of that summary can then be produced, or a trend analysis that compares that summary against some other log file or summary can be produced.

5.2 COLLECTION (DATA LOGGING)

5.2.1 General

Data are logged to a file specified by the Diagnose mode Logging option (Section 4). Data logging is enabled by setting this option to anything except NONE. The "LOG =" file specification and the extent of logging are described in detail in the following paragraphs.

5.2.2 LOG file device (.LOG)

"LOG =" specifies the file in which board data logging information will be collected. If left unspecified, or if only the device is indicated, the program will use the "NAME =" option on the Diagnose page and will create a .LOG extension. For either the default or an explicit file specification, the software searches for that file specification when the program is loaded. If an existing file is found, data are appended to that file. If no file by that name

is found, one is created. Therefore, if a separate device file is, for example, to be made for each work shift, or production run, etc, a separate file name or extension must be specified. Test data can be logged to two or more files in rotating order by running a batch file to change the LOG specification on the DIAgnose monitor page as each new shift begins.

The specified log file is opened when a test program is loaded, and new data are appended to it as the test program is executed (run time).

5.2.3 Time Stamps

The time and date of each main event associated with running a test program are always entered in the log file, regardless of the logging options chosen. Events are coded as single ASCII characters, as listed below, and then the time and date are entered.

```
[   Program loaded
@   Start testing board
?   Abort test
"   Passing board test ended
/   Failing board test ended
*   Error in test
&   System error
!   Cancelled test
]   Return to Diagnose mode
```

where:

Event	Action
Program loaded	Operator pressed the LOAD key.
Start testing board	The START button is pressed.
Abort test	User aborted the test by pressing either the RESET button or CTRL/C.
Passing board test ended	Test completed with no failures. (Vacuum is released.)
Failing board test ended	Records the time of completion for any board in which a failure was detected (vacuum released). This time includes that used for probing and printing diagnostics.
Error in test	Records the time that a failure such as a voltage source overload or current source compliance condition occurs.
System error	Records the time of a system error.
Cancelled test	After a board test has been completed, if the operator decides that the board-test data for that board should be ignored, the operator can press the RESET key. The system asks the following question: "Do you wish to cancel the last board's logging data? (Y/N)." If the keypad YES key is pressed, an entry is made in the .LOG file to cancel the logged data for the previous run. Alternately, CAN (for CANCEL), followed by the RETURN

Event	Action
Cancelled test (cont)	key, can be entered on the keyboard. If any other key is pressed, the logged data are retained. This action does not delete the data but inserts an exclamation point and a cancel time stamp (e.g., !22-AUG-82_11:15:30) in the log file which allows the report generator to disregard the data.
Return to Diagnose Mode	The test program is unloaded by entering the MONITOR command or pressing the MONITOR ENABLE or CRTL Z key. Control returns to the Diagnose mode.

The name of the test-program file (.OBC) appears only in the line containing the load program time. The symbols ([, @, ?, etc) identify the event that took place at that time. For example,

SC1:BOARDX.OBC[02-JAN-83_11:23:27

indicates that the test program SC1:BOARDX.OBC was loaded into the system at 11:23:27 on January 2, 1983.

5.2.4 Logging TIMES,+FAIL,+VALS,+PASSES Options

The extent of logging beyond TIMES is selectable. The choices build upon each other from minimum information to maximum information, as follows:

TIMES Time stamps recorded only for load, unload, start, stop, abort or cancel.

+FAIL Adds to time stamps the label and key after each failed component. ("Label" and "key" are explained in para 5.2.5.) For example,

```
R3>
R7<
```

Measured values are not logged.

+VALS Adds to time stamps, failing label, and key any measurement value for each failed component. For example,

```
R3>33.3K
R7<9.9K
```

+PASSES "Characterizes" the board by recording test results for all tested components. This selection adds limits and any test type to the data logged under VALS. For example,

```
Q9=-736.17M(-899.98M,-299.99M)V
```

where the measured value follows the equal sign. The limits are enclosed in parentheses and the test type, V for voltage in this example, follows the limits.

5.2.5 Logging Format

The unabbreviated format (+PASSES option) of a log-file output appears as follows:

Format

```
NL  label  key  value  limits  test type
```

where: NL — New line to designate the start of a new test entry. An NL precedes a label, resulting in one entry per line, as shown below for R6.

label — The label associated with the most-recently executed statement that had a label. Note that multiple measurements following the same label will have identical labels, e.g.:

```
R6<3.3K
R6=2.4V
```

key — A symbol indicating the results of a test:

=	passed test
<	failed high
>	failed low
#	no test
%	failed digital test
(S	shorts failure
(O	opens failure
(B	BUSTEST failure
(C	SCRATCHPROBING track/pin connection failure
(F	SCRATCHPROBING fixture failure

value — The measured value when applicable, e.g., 65.21K, 1.18U.

limits — The acceptable low and high test limits when applicable, e.g., (-899.98M, -299.99M)

test type — A 1- or 2-letter code defining the type of test, e.g., V for voltage, IS for current source, etc.

Examples

```
R3>3.1082K
R7<10.022K
```

Meaning: Resistor R3 measured 3.1082K and was lower than its acceptable limit. (Not the same meaning as the inequality expression R3 > 3.1082K.) Similarly, R7 measured 10.0221K and was higher than its acceptable limit.

```
Q9=-736.54M(-899.98M,-299.99M)V
```

Meaning: Transistor Q9 had a voltage measurement of -736.54 mV which was inside the limits enclosed by parentheses. V indicates a voltage test.

5.2.6 Log File Data

The Logging option can enable logging test results (e.g., high test, low test, no test, etc) and measured values (when applicable) obtained by the system instruments listed in Table 5-1.

Table 5-1
LOG FILE DATA FROM TEST INSTRUMENTS

Instrument	Test Results	Measured Values
DCM (dc measurement unit)	YES	YES
ACZ (ac impedance unit)	YES	YES
ARITH	YES	YES
DCS (dc source)	YES	NO
LGC (digital)*	YES	NO
OPENS	YES**	NO
SHORTS	YES**	NO

* The % symbol is followed by =IC TYPE = internal part number (if available in .IDD file).
**Only the first 40 characters in a failing node list are logged. The list is truncated if the list has more than 40, and a "+" symbol appears at the end of the list.

Formats

Note that devices DCS, digital tests, OPENS, and SHORTS do not obtain actual measurement values and thus only supply test results to the report generator.

The data logging formats for shorts and opens are:

(S <up to 40 characters of the short list>+
(O <up to 40 characters of the open list>+

NOTE
A "+" symbol following the list indicates that there were more than 40 characters in the list.

The logging format for digital failures is:

NAME %= IC TYPE = internal part number

for example: U1 %= 7400 = 203-7400-012

Since the internal part numbers can represent, for example, 2 different vendors of the same type of IC, both TYPEs and internal part numbers are collected.

There are 2 formats for logging BUSTEST failures, depending on whether an IC or a bus has been indicted.

When an IC is specified, the format is:

ICNAME%B=TYPE=PARTNUMBER

for example: U13%B=7453=5081-323

When a bus is indicted, the format is:

(B nodelist e.g., (B 60 83,117

There are 2 formats for logging SCRATCHPROBING failures, depending on whether an IC or a fixture nail has been indicted.

When an IC is specified the format is:

(C ICNAME.PIN, nodelist e.g., (C U11.6, 45,55,65,80

and indicates a bent or broken IC pin connection or a broken track.

When a fixture nail is specified, the format is:

(F nodelist e.g., (F 60,73,75,81

Example

The following example illustrates the contents of a typical log file created when LOGging is set to +VALs, NAME =BOARDX.OBC, and DEV =SC1:.

Log File	Comments
SC1:BOARDX.OBC[02-JAN-83_11:23:27	Program loaded
@02-JAN-83_11:27:26	Start testing
R68<819.2K	Resistor R68 failed high and measured 819.2K
C18>97.04P	Capacitor C18 failed low and measured 97.04 pF
/02-JAN-83_11:28:31	Failing board test ended

5.2.7 Data-Logging Considerations

The following items should be considered before any logging is performed.

1. Before reports categorized by internal part numbers can be generated, some changes in the source files must be made. What is edited depends on whether the parts are digital or analog and the status of the .CKT file. If digital part numbers are to be logged, add the part numbers in the MSG flagspec in the %VALUE: section of the .CKT file (if they are not already included). Since the IC "TYPE" is specified in the %CIRCUIT: section, and typically no entry is made in the %VALUE: section, the part number is added in the %VALUE: section for each IC:

```
%VALUE:2275;
U1 = MSG='part number';
```

When the .CKT file is changed, the ATG monitor options, circuit prepare and IDD prepare, must be rerun to update the .IDD file.

Analog part numbers can be added to the "MSG =" flagspec in the .CKT file (if they are not already there) and ATG rerun. The software automatically updates the FPMSG failure variable in each WRITE ID=LOGFILE '=%S%' FPMSG; statement. Refer to Section 6 of the 227X Test Set Preparation manual for a description of ATG (%VALUE:) and to the Test Programming manual for descriptions of failure variables and WRITE ID=LOGFILE statements.

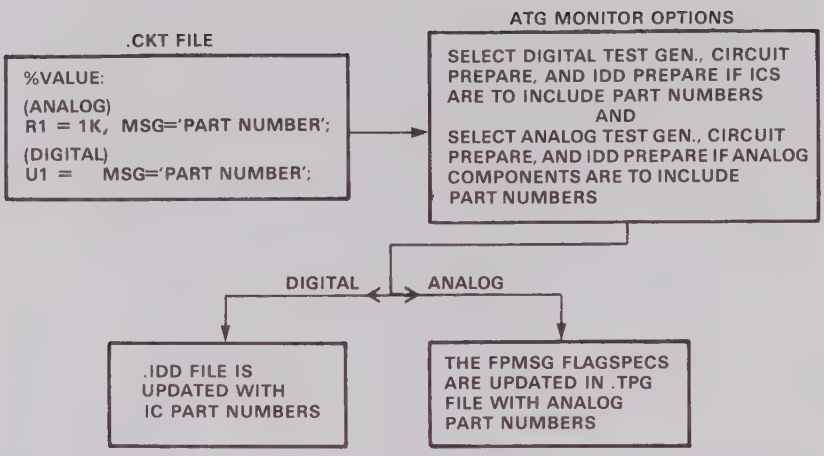
.CKT FILE
%VALUE:
(ANALOG)
R1 = 1K, MSG='PART NUMBER';
(DIGITAL)
U1 = MSG='PART NUMBER';
ATG MONITOR OPTIONS
SELECT DIGITAL TEST GEN., CIRCUIT PREPARE, AND IDD PREPARE IF ICS ARE TO INCLUDE PART NUMBERS
AND
SELECT ANALOG TEST GEN., CIRCUIT PREPARE, AND IDD PREPARE IF ANALOG COMPONENTS ARE TO INCLUDE PART NUMBERS
DIGITAL
ANALOG
.IDD FILE IS UPDATED WITH IC PART NUMBERS
THE FPMSG FLAGSPECS ARE UPDATED IN .TPG FILE WITH ANALOG PART NUMBERS

Figure 5-2. Data Logging, Including Internal Part Numbers.

For users who already had part numbers in the .CKT file prior to the last ATG run, it is only necessary to edit the WRITE ID=LOGFILE '%S%' FPMSG flagspecs in the .TPG file to add the equal symbol immediately before the % symbol ('=%S%').

Figure 5-2 illustrates the files affected when internal part numbers are to be collected.

2. Part numbers are truncated to 20 characters by the report generator.

3. When there are multiple test failures under a single test-program label as, for example, with transistor tests, all of these failures are collected. The report generator, however, acknowledges and reports only the first error encountered with that label. Any other associated errors are ignored. ATG will normally supply a label for every test it generates. However, a user modifying a test or preparing a hand-written test (for example, an analog library test) should add a label (and any applicable suffix) to each statement containing a test function.

5.3 LOGGING REPORT GENERATOR (LOG)

5.3.1 Introduction

Component data are logged to a concise ASCII file with a .LOG extension, as previously described. Though the logged data are in ASCII, they are not sorted or statistically processed. The data are analyzed and processed in this separate report-generator mode. A listing report file, a summary-data file, a trend report file, or board-level statistics can then be generated. Additionally, a plot of measured (passing and/or failing) values can be produced.

Except for PLOTS, which is described later, each report can have up to 3 types of information, depending on the Log mode options selected. These are:

Board name and report date/type
Board-level statistics (current and/or summary)
Failure data report or trend analysis

Examples of these sections are shown and described on the following pages.

5.3.2 Board Name And Report Date/Type

Figure 5-3 shows an example of the report header information.

```
                                                              Page 1
                    2275 DATA LOGGING REPORT

Board Name                      SC1:450.OBC

Report Date                     Thu 14-Apr-83_13:09:50 EDT

Report Type                     COMPONENT NAMES ONLY / ALPHA SORT
                                ALL FAILURES
              PLOTTING DATA FROM PASSING TESTS
```

Figure 5-3. Example of Report Header.

5.3.3 Board-Level Statistics (Current and/or Summary)

There are 2 types of board-test statistics: CURRENT and SUMMARY. Current statistics are presented when a report is made from the most-recently logged data (from a .LOG file). Summary statistics are presented when any report is produced involving summary data (from a .SUM file).

An example of each category of statistics is shown in Figures 5-4 and 5-5, followed by a description, in Figure 5-6, of those statistics requiring further explanation.

Figure 5-6 illustrates the relationship between test time and total elapsed time, which includes wait time and load and unload overhead times.

```
                                                              PAGE 2
                CURRENT STATISTICS File(s) = SR:450.LOG

From:     22-MAR-83_14:49:25  To:     26-MAR-83_21:43:45

                                      #                  %

Total Board Tests                     94              100.00
Passing Board Tests                   20               21.28
Failing Board Tests                   74               78.72

Aborted Tests                         11

Total Faults                         370
Average Faults / Failing Board         5.00

Total Elapsed Time                 (  09:16:21)       100.00
Total Testing Time                 (  02:13:20)        23.97
Total Waiting Time                 (  07:03:01)        76.03

Average Actual Board Test Time     355.12 seconds / board
Average Passing Board Test Time     75.20 seconds / board
Average Failing Board Test Time     87.78 seconds / board

Actual Board Throughput             10.14 boards / hour
Passing Board Throughput            47.87 boards / hour
Failing Board Throughput            41.01 boards / hour
```

Figure 5-4. Example of Current Statistics File.

SUMMARY STATISTICS File(s) = 450.SUM

From: 22-MAR-83_14:49:25 To: 26-MAR-83_21:43:45

	#		%
Total Board Tests	94		100.00
Passing Board Tests	20		21.28
Failing Board Tests	74		78.72
Aborted Tests	11		
Total Faults	370		
Average Faults / Failing Board	5.00		
Total Elapsed Time	(	09:16:21)	100.00
Total Testing Time	(	02:13:20)	23.97
Total Waiting Time	(	07:03:01)	76.03
Average Actual Board Test Time	355.12	seconds / board	
Average Passing Board Test Time	75.20	seconds / board	
Average Failing Board Test Time	87.78	seconds / board	
Actual Board Throughput	10.14	boards / hour	
Passing Board Throughput	47.87	boards / hour	
Failing Board Throughput	41.01	boards / hour	

Figure 5-5. Example of Summary Statistics File.

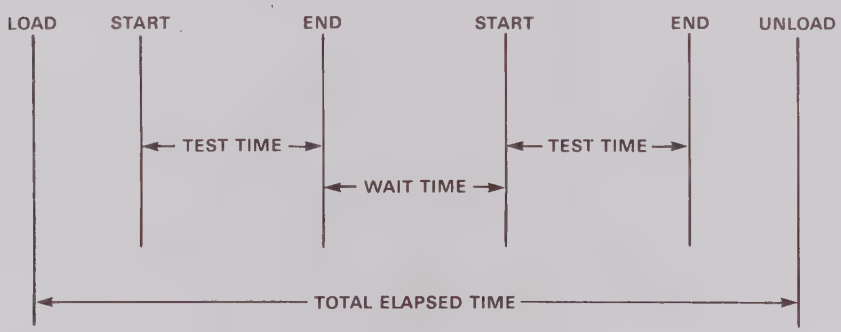

Figure 5-6. Testing Times.

Note that the actual board throughput and average actual board test times do include load/unload and intertest wait times. The pass/fail board average test times, however, do not include these non-board test times.

5.3.4 Failure Data Report or Trend Analysis

The failure data/trend analysis section can be presented, either by internal part number or component (.TPG label), in several ways:

All entries sorted alphanumerically
Only entries starting with a specific string such as R, CR, a common part-number prefix, e.g., 012-, etc, sorted alphanumerically
All failures sorted from frequency of occurrence (most often to least often)
The top "n" failing components

Figure 5-7 shows a hypothetical example of a trend analysis or failure report with all entries sorted alphanumerically. For a trend analysis, CURRENT data are taken from whatever is specified for the "LOGf =" input file option (Figure 5-10). The data listed in the SUMMARY column are derived from the "LOG2f =" to "LOG7f =" input-file specifications. If there are no "LOG2f =" to "LOG7f =" files specified, the data listed in the SUMMARY column default to the .SUM file. A comparison is made between these 2 columns. A significant deviation in the trend is flagged (!!!) and a footnote will appear at the bottom of the analysis. This deviation is explained in the data-reporting considerations (para 5.3.9).

COMPONENT NAME	NUMBER OF FAILURES		FAULTS PER FAILING BOARD	
	CURRENT	SUMMARY	CURRENT	SUMMARY
1234-5678	0	6	0	1.5
5435-6776	1111	123456	99.9	87.5
NO P/N SPECIFIED	3	7	3.5	2.2
OPENS	1	1	2.9	.8
SHORTS	15	5	44.1	1.3!!!

!!! --> Significant increase in failure rates detected.

Figure 5-7. Example of Failure Data Report.

5.3.5 Begin and End Time for .LOG Analysis

A specific period within the log file can be listed by specifying times for the period of interest. The times are specified by the Begin and End time options on the LOG Mode page (Figure 5-10). The times are entered in the format:

DD-MON-YY_HH:MM:SS

The entries must conform to this format to be accepted, though there are some applicable defaults (para 5.3.7) and the time-window considerations shown in Figure 5-8. Data are collected from the first LOAD following the Begin time through the pass (to the UNLOAD time) in which the End time is specified.

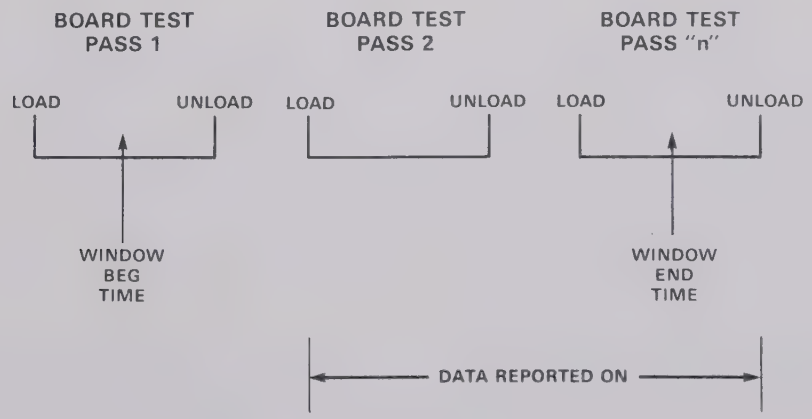

Figure 5-8. Time-Window Definition.

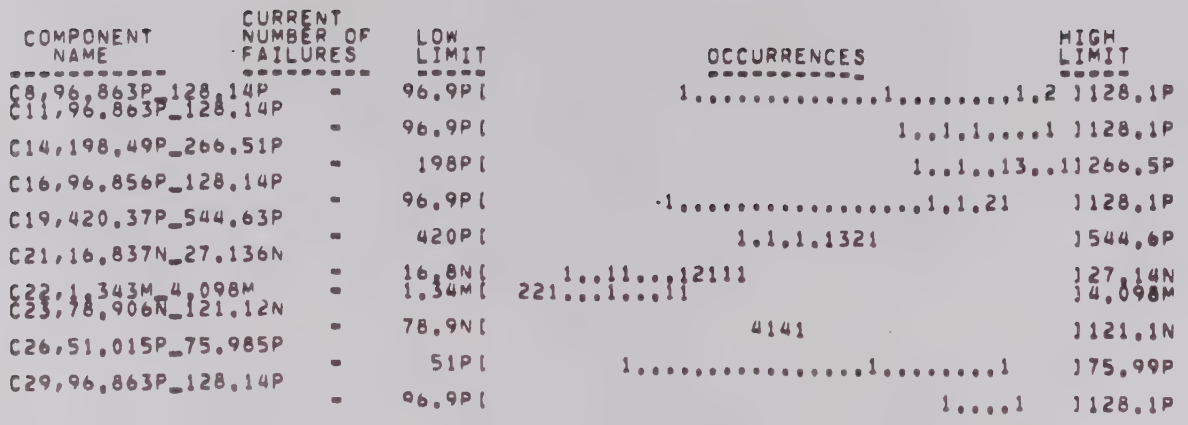

Figure 5-9. Sample Plot.

5.3.6 Plot

The report generator features a form of histogram that produces a visual representation of the distribution of measurements for any component. The representation can be limited to just components that passed their individual tests or can include all passing and failing component measurements. With Plot, there is a rough visual indication of where in the acceptable test limits the measurements are occurring. An analysis of the tolerances can be made. Are the limits unnecessarily wide? Is the distribution symmetrical? Is the distribution centered within the limits? Has the distribution deviated within acceptable limits relative to another production lot or time period?

There are 3 types of plots available:

GOOD BOARDS — A plot of passing components is made only from boards that completely passed all component tests.

PASSES — A plot of passing components is made regardless of whether or not the board passed or failed.

ALL — A plot is made of all measurement data. In this case, the plot extends beyond the component test limits to accommodate the failing tests.

Figure 5-9 shows a sample plot for some capacitors. The component label is listed in the first column; then a comma, used as a separator, is followed by the limits. The second column lists the number of times the component was measured outside the limits. The next 3 columns form the plot. The low limit is followed by a bracket ([). Another bracket (]) precedes the high limit located in the right column. The brackets define the plot. The plot is separated into 40 bins (spaces). The resolution (bin width) is:

$$\frac{\text{High Limit} - \text{Low Limit}}{40}$$

The indication of the number of times a measurement falls within a given bin is denoted by a single number or character, either 0-9, A-Z or an *. When the frequency is between 1 and 9, the number 1 through 9 appears. The letters A-Z denote a frequency of 10 to 35. The letter A appears for a frequency of 10, B for 11, C for 12, etc, through Z for 35. An asterisk (*) denotes a frequency greater than 35.

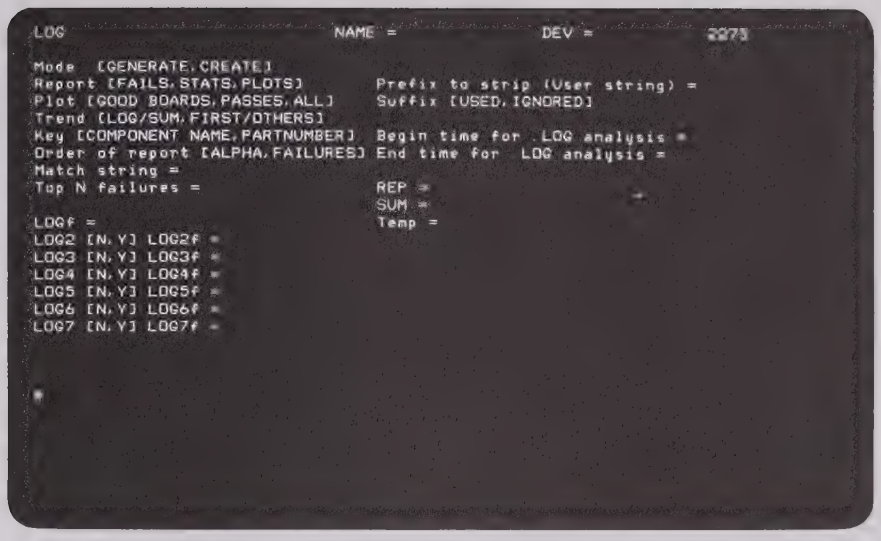

Figure 5-10. LOG (Report Generator) Monitor Task Options Page.

5.3.7 Log (Report Generator) Mode

The Log Mode, described in the previous paragraphs, is used to select a specific report type from the data logged during board testing. The Log mode options page is shown in Figure 5-10.

Mode [GENERATE,CREATE]

[GENERATE] The GENERATE mode produces a report file (.REP) from one or more input files (.LOG and .SUM). Input files are specified in the "LOGf =", as well as the "LOG2f =" through "LOG7f =" file spec options.

[CREATE] The CREATE mode produces a summary file (.SUM) from one or more input files. The .SUM output file includes board-level statistics and SUMMARY statistics from all input files. Though this file is an ASCII file, it is a special-purpose file not intended for user modification. (Refer to para 5.3.8.) After a summary file is created, it is intended only as an input file for the report generator.

NOTE

Refer also to the Data Reporting Considerations (para 5.3.9).

Report [FAILS,STATS,PLOTS]

Selects the type of report that is to be produced by the report generator.

[FAILS] The FAILS report consists of board-test statistics and a report of failures in a format as selected by the Trend option described below. No data plot is given.

[STATS] The STATS report is a listing of board-level statistics. This information includes the number of boards tested, the number of passing and failing board tests and aborted tests. Also included are total-elapsed-time, total-testing-time, and total-waiting-time statistics. Finally, the average actual board-test time, average passing and failing board-test times, as well as actual board, passing and failing board throughput times are recorded.

[PLOTS] The PLOTS report produces a visual representation of the measured values in the .LOG files for each component. This is a frequency distribution of passing measurements within the prescribed limits. When PLOTS is selected as the report type, a "Plot" sub-type is selected, as described below, to qualify further the data to be plotted. (Note that PLOTS can only be run if the logging +PASSES option is selected, as described in para 5.2.4.)

Plot [GOOD BOARDS,PASSES,ALL]
Selects the amount of information to be included in the generated report.

[GOOD BOARDS] When a plot of GOOD BOARDS is selected, a frequency distribution is produced of the measurements of all passing components from only those boards that had no test failures (green-lighted boards). This is not a plot of any type of board-level statistic.

[PASSES] When a plot of PASSES is selected, a frequency distribution is produced of the component measurements that passed their component tests, regardless of whether or not the board passed.

[ALL] When a plot of ALL is selected, a frequency distribution is produced of all .LOG file measurements. This includes those component measurements that have no limits. Certain component tests, for example, diode tests, contain compliance tests that have no measurement limits and, indeed, are expected to fail before a diode test can pass.

Trend [LOG/SUM,FIRST/OTHERS]
[LOG/SUM] If the LOG/SUM trend is selected and the "Mode" is set to GENERATE, a trend analysis report is produced. A ready comparison can be made between all .LOG files (listed in the CURRENT column) and all .SUM files (listed in the SUMMARY column).

[FIRST/OTHERS] The FIRST/OTHERS trend produces a report for comparing the first ("LOGf =") file to any other files specified in the "LOG2f =" through "LOG7f =" input files. The FIRST data are listed in the CURRENT statistics of the report; the OTHERS data in the SUMMARY statistics.

Key [COMPONENT NAME,PARTNUMBER]
The components listed in the report file can be sorted either by name or by part number, as selected by this option.

[COMPONENT NAME] When COMPONENT NAME is selected, the report is sorted by component names.

[PARTNUMBER] When PARTNUMBER is selected, the report is sorted by part number.

Order of report [ALPHA,FAILURES]
The order of components listed in the report can be arranged either by name, alphabetically, or by frequency of component failures.

[ALPHA] The report is sorted alphabetically.

[FAILURES] The report is sorted by components with the most failures presented first.

Match string =

The report is limited to just the failing components for a given component or the part-number class specified by the match string (e.g., R for resistors, CR for diodes, a string assigned 4306- for all part-numbered components that start with 4306-, etc) in alphabetical order.

Top N failures =

This numerical entry (other than a 0) limits the report to just the top n failing components.

Prefix to strip (User string) =

This optional text string specification is removed from any component label in the .LOG file. If not otherwise specified, any $ or T preceding the component label is removed.

Suffix [USED,IGNORED]

Some components have more than one type of test. For example, inductors have both inductance (L1_L) and resistance (L1_R) tests. When USED is selected, the suffixes (defined as an underscore followed by a label) are kept. In this example, the suffixes are _L and _R and distinguish the multiple tests.

[USED] When USED is selected, multiple tests for the same component are reported as if they were different components.

[IGNORED] Any suffix (underscore followed by a label) is ignored. For a component that has two tests with differing suffixes, the test results are listed together under the heading for that component.

Begin time for .LOG analysis =

End time for .LOG analysis =

A .LOG file can be partially listed by specifying times for the period of interest. The times are entered in the format:

DD-MON-YY_HH:MM:SS

The entries must conform to this format to be accepted, though there are defaults and other considerations. The year, time of day, and entire date specifications have the following defaults:

The year YY defaults to the current year.
The time HH:MM:SS defaults to 00:00:00 if Begin is specified and to 23:59:59 if End is specified.
The date and time specifications must be separated by an underscore.
If not specified, the date defaults to 01-JAN-70 for Begin and to the current date for End.
Leading zeroes are not required in the date/time specification.

Refer also to the time-window definition shown in Figure 5-8.

LOGf =

This is the first input file specification from which the report will be made. Note that for a trend analysis this file is compared to either .SUM files (LOG/SUM) or the other LOG2f-LOG7f files (FIRST/OTHERS).

LOG2 [N,Y] LOG2f = through
LOG7 [N,Y] LOG7f =

These are additional input file specifications used in trend analysis and merging data bases.

REP =

This is the report output file specification when the GENERATE sub-mode is selected. If not otherwise specified, the "NAME =" and "DEV =" specifications are used, along with the extension .REP.

SUM =

This is the summary output file specification when the CREATE sub-mode is selected. If not otherwise specified, the "NAME =" and "DEV =" specifications are used, along with the extension .SUM.

Temp =

This required device specification designates the disk surface where intermediate files involving the statistics are made. Normally, these files are automatically deleted after the report processing. Typically, a disk such as SC1: is specified.

5.3.8 Summary File (.SUM) Format

A .SUM file is produced when the report generator CREATE mode is run. Figure 5-11 shows a line-by-line example of the format of a .SUM file.

NOTE

The .SUM file is not intended for user modification.
This example is shown for information only.

SAMPLE .SUM FILE

```
                                .SUM file header
1  Wed 17-SEP-82__09:05:40 EDT...Creation day/time
2  22-MAY-82__14:49:25           From time
3  26-MAY-82__21:43:45.....To time
4  DK3:450.OBC                  .OBC filename
5  105.....Total number of passes
6  20                           Total number of good passes
7  74.....Total number of failing passes
8  11                           Total number of operator aborts
9  0.....Total number of operator cancels
10 370                          Total number of P/N entries
11 370.....Total number of component name entries
12 33381                        Total elapsed time (in seconds)
13 1504.....Total passing test time (in seconds)
14 6496                         Total failing test time (in seconds)
C1}1 0.....Component name entry (}
C3}1 0                          Component name entry (}
C4}1 0.....Component name entry (}
C9}1 0                          Component name entry (}
CR2}2 0.....Component name entry (}
CR3}6 0                         Component name entry (}
No P/N specified {370 0.....P/N entry ({)
154                             Total number of distinct entries in this file.
```

Figure 5-11. Summary File (.SUM) Format.

5.3.9 Data-Reporting Considerations

The following items should be considered before any report is produced.

1. With digital IC failures that include part numbers, an apparent discrepancy exists between the number of total faults in the STATISTICS section of the report and the number of failures (if totaled) in the report section. This is because the number of TYPE failures is listed separately from the number of part-number failures. For example, consider the following logged digital failure:

   IC1%=7400=5431-8200

   where the TYPE is 7400 and the part number is 5431-8200. A failure of this type is logged by both TYPE and part number. In this manner, a correlation of totals by either category can be obtained.

2. The flag !!! appearing in a report indicates a significant increase in the number of faults per failing board. (Refer to the 2 columns underneath the heading FAULTS PER FAILING BOARD; see Figure 5-7.) The significance of this increase is determined by the formula:

   $$a - b > 0.1 + (1 / \text{number of failing boards})$$

   where: a the listed number of current faults per failing board
   b the listed number of summary faults per failing board

Using GRnet — Appendix A

A.1 THE 227X MONITOR

The 227X Network mode is implemented via a Network monitor page. The 227X Network monitor page is easy to use:

a. Access the 227X Network mode from the full 227X monitor by entering

#NET

and pressing the RETURN key on the keyboard. Once the NETwork mode has been entered, the monitor page, shown in Figure A-1, is displayed.

The Networking utility is used to perform operations via the GRnet networking system. A GRnet system is a dedicated ATE (automatic test equipment) data link that permits development, storage, and management of data files (such as test programs, text files, etc) at a central programming station. These files can then be transferred from the central station to the test system or from one test system to another using the network.

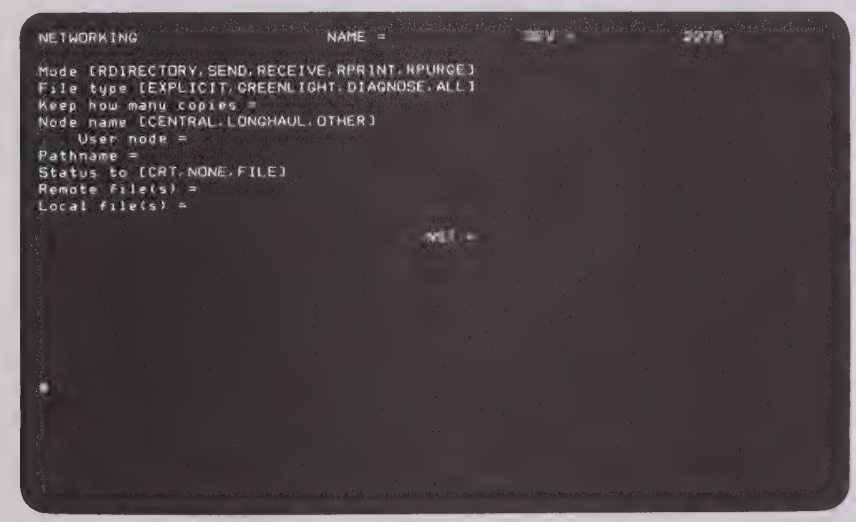

Figure A-1. Network Monitor Page.

Mode [RDIRECTORY,SEND,RECEIVE,RPRINT,RPURGE]
Specifies which networking function is to be performed when utility is run.

[RDIRECTORY] Displays or writes the remote station user-file directory (UFD) specified by the "Pathname =" option on the device specified by the "Local file(s) =" option. The device is typically TI:.

[SEND] Transfers files to a remote station. Files from the system are specified by "NAME =" (or "Local file(s) ="), "DEV =" and the "File type" option. The remote station user-file directory is designated by the "Pathname =" option. A file can be renamed if specified by the "Remote file(s) =" option.

[RECEIVE] Transfers the file or files from the remote station. Files to be received are specified by "Remote file(s) =" and "File type" option; the remote station user-file directory is designated by "Pathname =". File names are changed to names specified by "NAME =" (or "Local file(s) ="), and "DEV =" options.

[RPRINT] Prints file on a remote station line printer. "Pathname =" is usually PRINT. The file or files to print are specified by the "NAME =" (or "Local file(s) ="), "DEV =", and "File type" option.

[RPURGE] Permits deletion of obsolete revisions of a file (or files) at the remote station in reverse order from the latest revision (latest version is always retained). Remote station user-file directory is specified by "Pathname =", files being purged are specified by "Remote file(s) =", and the number of most recent revisions to remain are specified by "Keep how many copies =" (default is 1).

File type [EXPLICIT,GREENLIGHT,DIAGNOSE,ALL]

[EXPLICIT] Only the files specified in the "NAME =" or "Local file(s) =" options are transferred during a Send operation or printed during an Rprint option. Only the files specified by the "Remote file(s) =" option are sent during a Receive, purged during an Rpurge operation, or listed in a directory during an Rdirectory operation.

[GREENLIGHT] The files required for testing a board are transferred. This includes the .TPG (test-program source) file, the .OBC test program binary (object code) file, the .SMT (symbol-table) file, and the .IDD (In-circuit Diagnostic Data) file, when available.

[DIAGNOSE] Only the .OBC and .IDD files as described for GREENLIGHT are transferred, etc.

[ALL] All files associated with a board name of function (pathname) are transferred, etc.

Keep how many copies =

This is a decimal number (usually 1 or 2) that specifies the number of most-recent revisions of a file at the remote station that are saved in an Rpurge operation. All earlier revisions of the same file are deleted. The default level is 1.

Node name [CENTRAL,LONGHAUL,OTHER]

[CENTRAL] The default option; indicates that the 227X system, at which you are working, is a satellite system in a GRnet local network. All network operations are performed between the 227X and the central station.

[LONGHAUL] Network operations will be performed via a GRnet Longhaul link connection. (Refer to 2291 System Operation manual.)

[OTHER] Network operations will be performed between the 227X system and the node specified in the "User node =" option. This option will usually be used only when the 227X at which you are working is the network master node.

User node =
Specifies a remote node in a GRnet local network with which a 227X, functioning as a central station, communicates.

Pathname =
Specifies a unique pointer to a device and user-file directory at the remote station where all files related to a specific board type reside. The pathname is limited to 16 characters and is established at the remote station by the network manager. Pathnames are used to simplify the task of locating files.

Status to [CRT,NONE,FILE]

[CRT] Any status messages are sent to the terminal device that initiated a network operation.

[NONE] No status messages are reported to the user.

[FILE] Any status messages are sent to the file specified by the "NST =" option. If no file is specified, then a file with the "NAME =" entry and the extension .NST is automatically created on the "DEV =" device as the status output file.

Remote file(s) =
This specification defines the file name (or names) of files at the remote station (extension and revision number are optional). Normally, this entry is null, except when performing Rpurge and Rdirectory operations, but is required for Receive operations. This specification also permits renaming of a single file, if desired, during a Send operation.

Local file(s) =
This specification defines the file name (or names) of files at the test system (extension and revision number are optional). The minimum entry required for this option is the local file device name. This option is used to specify files to be transferred to the remote station during a Send operation and is used to rename a file, if desired, during a Receive operation.

NST =
This entry is used to specify the name of a status message file. If this entry is null, then the system creates a status file with the device and name from the "DEV =" and "NAME =" options and with the .NST extension.

An example of an operation using the Networking utility is shown in Figure A-2.

In Figure A-2, the Networking utility is being used to receive all files required for diagnosing the board named BOARD2 (files BOARD2.OBC and BOARD2.IDD). The files are located on a central station UIC with a pathname of USER. Status messages are directed to the terminal.

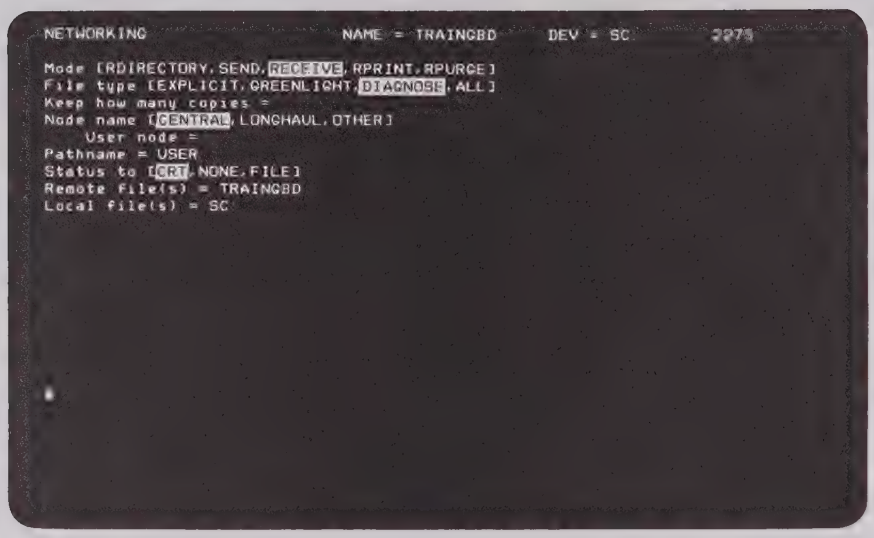

Figure A-2. Sample Networking Monitor Page.

A.2 NETWORK-BATCH OPERATIONS

A.2.1 Introduction

General

A series of tasks or jobs may be performed automatically, in sequence, through the use of 227X Batch-mode processing with a minimum of operator intervention. Any mode controlled by a GenRad monitor may be run under Batch by creating the proper batch file.

Batch programs can also be written to perform routine functions involving network operations, so as to:

Simplify board testing procedures for the test-system operator by using a batch file to remove previous test files from the system's disk, display a help file explaining special instructions for testing of a particular board, then obtain all files that are needed to test that particular board, and set testing options for Diagnose mode,

Simplify the procedures for obtaining directory listings of central station pathnames,

Simplify procedures for printing test files on line printers, and

Simplify procedures for permanently storing test files.

By using batch programs in conjunction with networking, the efficiency of your circuit-board testing can be improved. This increase in efficiency is realized because there is no need to change test-system disks, there is less test-system operator confusion, and testing procedures are developed and saved in batch files that can be run with simple commands during the test cycle.

GenRad-Prepared Batch Programs in the PCB Testing Cycle

GenRad supplies several batch programs already written for use with the network, which perform the functions described above. The test engineer (or other test-program developer) needs only to alter these programs during test-system program preparation for each printed-circuit board (pcb).

These programs are intended to be modified to fit a model test-program development cycle, with the result that batch files are used to incorporate networking into the everyday testing cycle. Figure A-3 illustrates this procedural model. In this model, the GenRad-supplied version of the batch program is used as a re-usable "template" for the batch program associated with each pc board's test program. The test-system operator then uses the network, and the test-system BATch mode, to transfer files and perform set-up of the system in a simple and efficient manner. It is assumed that the test-system operator and the test engineer are familiar with the use of Batch for their test system.

The following paragraphs describe the procedures necessary to prepare batch files for use and how to execute them on a 227X test system. At the end of this section, the complete contents of the GenRad-written batch programs, and their use, are given for quick reference.

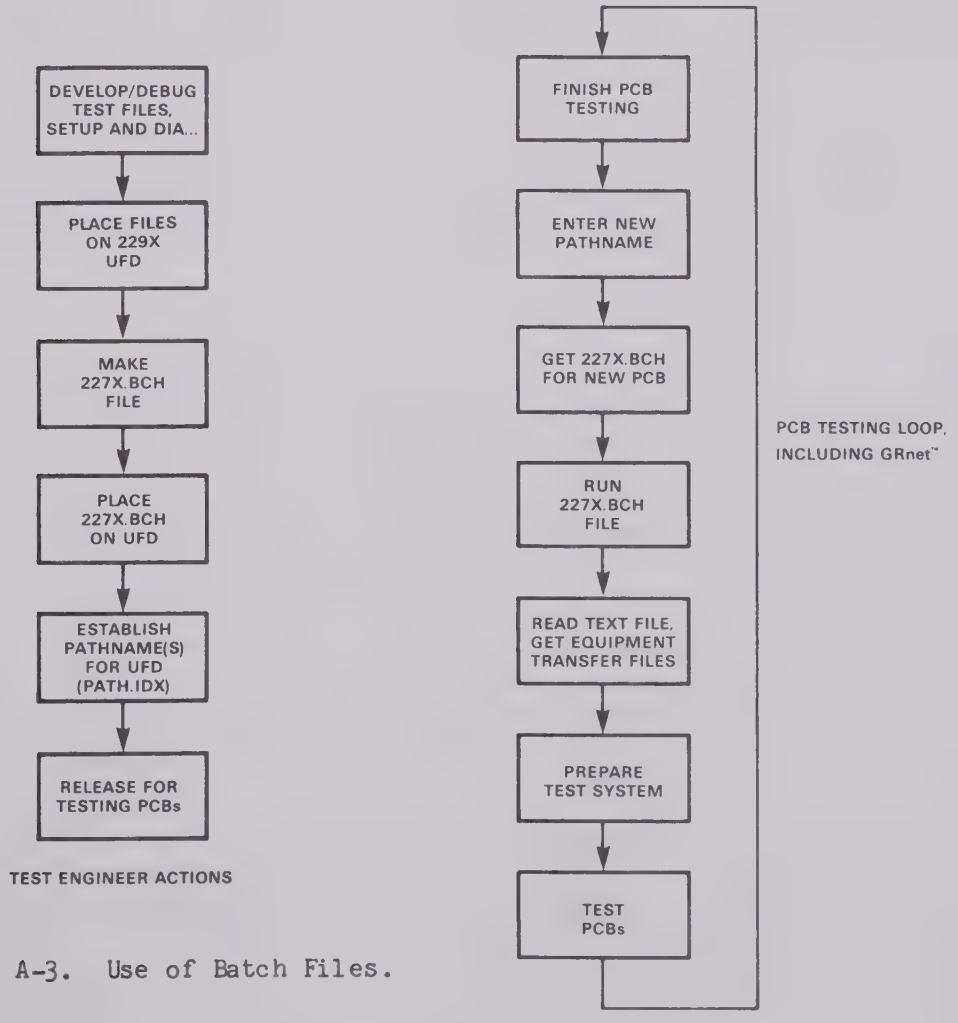
DEVELOP/DEBUG TEST FILES, SETUP AND DIA...
PLACE FILES ON 229X UFD
MAKE 227X.BCH FILE
PLACE 227X.BCH ON UFD
ESTABLISH PATHNAME(S) FOR UFD (PATH.IDX)
RELEASE FOR TESTING PCBs
TEST ENGINEER ACTIONS
FINISH PCB TESTING
ENTER NEW PATHNAME
GET 227X.BCH FOR NEW PCB
RUN 227X.BCH FILE
READ TEXT FILE, GET EQUIPMENT TRANSFER FILES
PREPARE TEST SYSTEM
TEST PCBs
PCB TESTING LOOP, INCLUDING GRnet™

Figure A-3. Use of Batch Files.

A.2.2 Test-System Operator Activities and the PCB Testing Loop

This paragraph describes the activities of the test-system operator during board testing.

Once the test programmer has loaded the board test programs on to the path, the operator of the test system need only follow the procedure described below for automating board loading and testing. The pathname for the UFD containing the test files for boards to be tested (or the board number, if used as the pathname) should be obtained from the network manager or test engineer.

a. When the operator is ready to test a group of boards, he enters the commands:

```
#NET
#PATH=NEWPATH (This is the pathname to be accessed.)
#BAT
#BCH=GET
#RUN
```

b. These Batch mode commands cause the transfer of the 227X.BCH files. These files, in turn, transfer a text file, prepared by the test programmer, indicating what device adaptors or other equipment is needed for testing the printed circuit boards. The operator now has time to obtain all the necessary equipment for testing.

c. While the operator is obtaining the required test equipment, the Batch mode command files are transferring all the necessary test files and setting the necessary Setup and Diagnose mode options for testing. After these operations have been performed, printed-circuit-board testing can begin.

A.2.3 Test Engineer Activities

General Procedure

It is the responsibility of the test engineer to do the preparation that is necessary to permit the test-system operator to use networking effectively. To do this, it is recommended that the test engineer edit "template" batch programs and integrate these files into the test-program development cycle. A general procedure is defined below. (Refer to the sample programs at the end of this section for the contents of the batch files and to determine what editing is necessary.)

a. Complete normal test-program development and test-program debugging for the printed-circuit board. At this time, any ATG mode, Diagnose mode, Setup mode or other options should be set and saved in batch files. Any text files that provide special instructions to the test system operator (the .TXT file) can also be prepared.

b. Have the 229X system manager create a UFD for these test programs. One recommended method of establishing these UFDs is to dedicate one UFD for all the programs for a particular board. A recommended numbering scheme is to use the numbers [200,1] through [200,377], with each UFD assigned to a different board. For larger numbers of boards, use [201,1] through [277,277]. Place all the test programs on the UFD.

c. Transfer a copy of the GenRad-written "template" batch files to the UFD assigned to the board. Edit these programs as necessary (in accordance with the descriptions given in the comments, as shown in the MAK227X.BCH example file in para A.2.6. Table A-1 lists the purpose of these files for 227X program development. Full implementation of the model for automation of network operations requires that a 227X.BCH and a .TXT file be created.

Table A-1
227X BATCH PROGRAMS

Program	Function
227X.BCH	This is the basic 227X batch program that is executed by the test system operator. The template for this file is named ND:[2,31]MAK227X.BCH. The purpose of the 227X.BCH file is to clean previous files from disk, to transfer and display a text file containing instructions for the system operator, and to transfer all files needed to test printed-circuit boards.
GET.BCH	This file transfers the 227X.BCH file on an operator-specified pathname.
NAME.TXT	(where NAME is the name of the .TPG file) This file is displayed at the terminal on command from 227X.BCH and is optional. This is a test-engineer-written text file containing special instructions for the test-system operator.

d. Enter the PATH.IDX file and establish the pathname to access the test files and Batch programs that have been created. The programs can now be used for testing printed-circuit boards on the production line.

227X Preparation

The specific actions performed by the test engineer for preparation of the pcb testing loop are outlined as follows:

a. The test engineer performs 227X program preparation in the normal manner.

b. Establish a unique UFD (with the UFD command) and pathname for the test files (by editing the PATH.IDX file at the 229X Central Station). The network manager may be required to do these operations.

c. Transfer all the testing files to the new UFD with the commands:

```
PAT=(enter the pathname for this board's files)
LOC=FILENAME (filename, without extension, for this board)
FIL=(ALL, GRE, or DIA, as appropriate)
```

d. Edit the file MAK227X.BCH, as described in para A.2.6. Rename the file 227X.BCH. These operations are performed by the 227X editor with the commands:

```
EDI
INP=MAK227X.BCH
OUT=227X.BCH
```

e. Transfer this file to the master 229X UFD containing all the files for the board.

f. Prepare a text file that includes any special testing instructions for the circuit board to be tested. These instructions can include items such as obtaining special test equipment (e.g., device adaptors and probes), precautions that must be taken by the operator because of static-sensitive devices on the circuit board, disposition of the boards after testing, etc. The name of this file should be the same as the name of the .TPG file for the board, with a .TXT extension. Send this file to the master 229X via the board pathname. (This may also be done at the 229X.) Figure A-4 is an example NAME.TXT file.

```
------------------------------------------------------------------------

                    SET-UP PROCEDURE FOR 1731-4730
                    ------------------------------
                          1731-4730 CPU CARD
                    ------------------------------

1731-4730 USES DEVICE ADAPTOR ANQ314, WHICH SHOULD BE LOCATED
ON SHELF 4 SLOT D.

------------------------------------------------------------------------
```

Figure A-4. Sample .TXT File for 227X Testing.

The test system operator can now run the batch programs as described in para A.2.2.

A.2.6 Template 227X Batch Programs

There are two 227X Batch programs that have been written by GenRad for use with networking. Comments are included in the listing of these programs to indicate where the test engineer must modify these "templates" to integrate these programs into the board-testing cycle.

GET.BCH File

This command file transfers the file 227X.BCH to the 227X. GET.BCH must be placed on every pathname with testing files. The only modification that can be made to this file is to specify the location of the 227X.BCH file on the 227X, when that file is transferred.

```
#NET
#REM=227X.BCH
#LOC=DEV: /TEST ENGINEER SHOULD CHANGE DEV: TO A LOGICAL DEVICE/
#FIL=E  /NAME LIKE SCn:/
#STA=CRT
#REC

#BAT
#BCH=227X.BCH
```

MAK227X.BCH Program

A "template" for the 227X.BCH program, which is copied and modified for each board to be tested, is shown. This file causes the transfer and display of a text file (which provides the operator with instructions for testing the specific board) and then transfers the files necessary for testing the board. The comment lines are not part of the program. When editing of the file is completed, rename it to 227X.BCH

```
#DEL
#DEL=DEV:*.*;*      /* DELETE ANY OLD FILES ON THE DEFAULT UFD */
                    /* TEST ENGINEER MUST SPECIFY DISK DEVICE FOR FILES */
#RUN

#NET
#REM=BOARD.TXT      /* ENTER NAME OF .TXT FILE FOR THIS BOARD */
#LOC=DEV:           /* SPECIFY 227X OUTPUT DEVICE (SAME AS ABOVE) */
#FIL=E
#STA=CRT
#REC

#TYPE
#INP=DEV:BOARD.TXT /* ENTER DEVICE AND NAME OF .TXT FILE */
#RUN

#NET
#REM=BOARD          /* SPECIFY BOARD FILE NAME */
#LOC=DEV:           /* ENTER 227X DEVICE FOR FILE */
#FIL=D
#STA=CRT
#REC

#DIA
#NAM=BOARD          /* SPECIFY FILE NAME FOR BOARD */
#DEV=DEV:           /* SPECIFY DEVICE FOR OBJECT FILE */
#MOD=TEST           /* SPECIFY TEST MODE */
#FIX=IGN            /* SPECIFY APPROPRIATE USE OF FIXTURE-ID */
#MESS=FILE          /* SPECIFY MESSAGES TO FILE */
#SCR=NONE           /* SPECIFY APPROPRIATE SCRATCHPROBE OPTION */
#DIG=NAMES          /* SPECIFY DIAGNOSTIC MESSAGE FORMAT */
#LOGG=TIMES         /* SPECIFY USE OF LOGGING OPTION */
#CON=NO             /* SPECIFY CONTINUE WITH DIGITAL AFTER ANALOG SHORT */
#OBC=               /* SPECIFY OBC FILE DEVICE */
#IDD=               /* SPECIFY IDD FILE DEVICE */
#TEM=               /* SPECIFY TEMPORARY FILE DEVICE */
#LOG=               /* SPECIFY LOGGING FILE DEVICE */
#MES=               /* SPECIFY MESSAGE FILE DEVICE */ */
#RUN

#NET
#REM=               /* NAME CENTRAL FILE */
#LOC=DEV:BOARD.LOG /* SPECIFY 227X FILE NAME AND DEVICE */
#FIL=E
#STA=CRT
#SEN
#RUN
```

Using the TRACS System — Appendix B

B.1 INTRODUCTION

The Test and Repair Analysis/Control System (TRACS) improves repair-process productivity by reducing the time needed to find and repair defects. Productivity enhancements result from smoother and quicker integration among the test, fault analysis, and repair groups in the board manufacturing process. This is accomplished by having all test stations in a production facility send test results to a TRACS central station. The TRACS central station stores data about test, analysis and repair of pc boards. These data are available to the TRACS 2701 Production Workstation for board analysis and repair. The relationship of the 227X test system to other parts of a TRACS network is shown in Figure B-1. Detailed descriptions of the operation and structure of a TRACS system are contained in the TRACS User's Guide (Central Station) and the TRACS 2701 Production Workstation User's Guide

A 227X test system can perform two TRACS functions.

Test boards and send test result information to the central station.

Provide analysis information to be sent to the central station along with the test result.

Testing in the TRACS mode at a 227X test station differs in two ways from testing without this mode.

1. The Diagnose monitor page and sub-mode pages have several new options and prompts that require responses. Additional commands have been added for responding to TRACS requests.

2. A bar-code wand can be used for entering pc board and operator identification information.

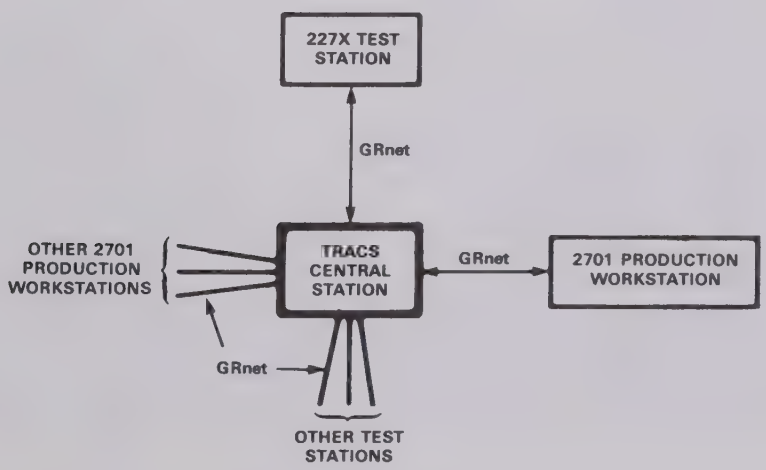

Figure B-1. Relationship of Test System in TRACS Network

This section describes the procedures for using the TRACS mode and local analysis, in the production environment, with the 227X family of GenRad testers.

B.2 USING THE BAR-CODE READER (WAND)

A bar-code reader, also referred to as the wand, is used primarily for the reading of bar-code serial numbers located on the boards to be tested. Other applications include reading of board type, process type, serial number and operator identification and passwords. During TRACS operation, you can enter this type of information either by reading a bar-code label with the wand or by using the system keyboard.

Figure B-2 illustrates the proper use of the wand. To use the wand:

a. Hold the wand as though it were a pencil (at an angle of 10-30 degrees from vertical).

b. Place the tip of the wand lightly on the label in the white area to the right or left of the bar code. The code can be read from right-to-left, or left-to-right, whichever direction produces the best result for you.

c. Quickly and smoothly draw an imaginary straight line through the entire code, using your arm (rather than your wrist) in the motion.

d. Listen for a "beep" to confirm successful input. (The speaker volume level control is located on the right side panel.)

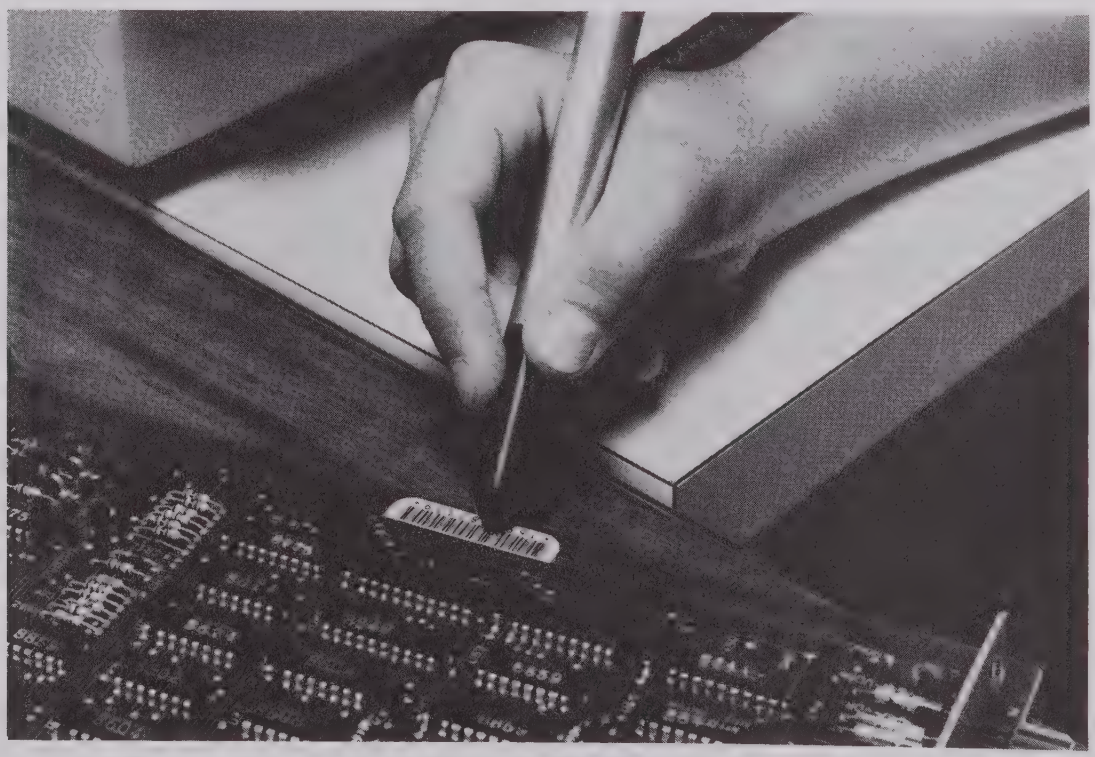

Figure B-2. Using the Wand.

Check the following if you are unsuccessful at reading the bar code:

Are you reading at the correct speed? Experiment with a faster, then slower, speed.

Are you pressing down too heavily? Sweep lightly, still touching the label.

Are you holding the wand at the correct angle? The angle should be 10 to 30 degrees from vertical.

Are you beginning and ending the scanning with the tip of the wand totally in the white margin on each side of the code? Try starting the sweep from completely off the code label.

If you do not hear a beep after several attempts at reading a bar code, call your system manager.

B.3 SELECTING TRACS OPTIONS

The TRACS mode is enabled by selecting TRACS in the Mode option line of the Diagnose monitor page. If the monitor is in Limited mode, this option line does not appear; therefore, the Unlimited monitor mode must be entered. The selection can then be made and the monitor returned to Limited mode. The mode remains set until specifically changed. Refer to Section 3 for information on monitor operation.

When the TRACS mode is selected, the Diagnose monitor page will appear with the additional options shown in the right-hand column of Figure B-3. TRACS mode is actually Test mode with TRACS added. Thus, testing is performed as in Test mode, but with the operator responding to TRACS options and prompts.

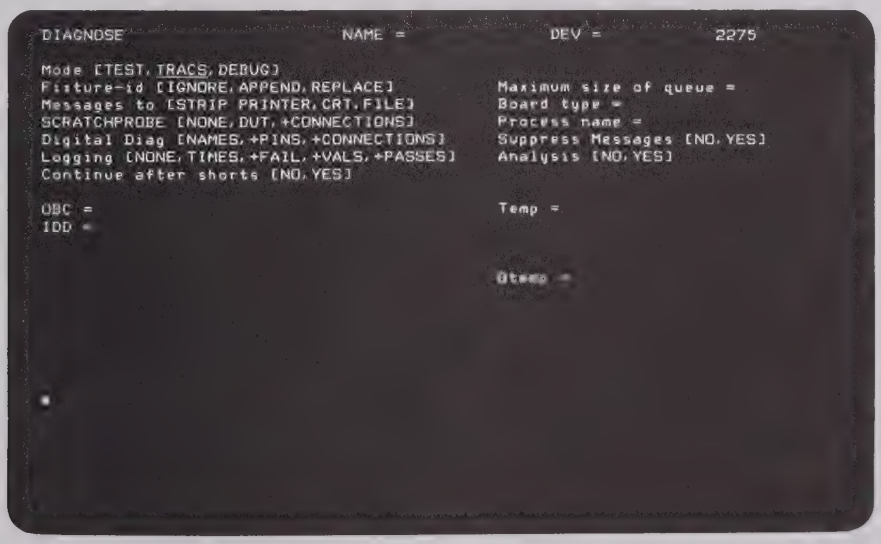

Figure B-3. TRACS Options on the DIAGNOSE Page of the Monitor.

Mode [TEST,TRACS,DEBUG]

This option line appears only in the Unlimited monitor. It provides for selecting the TRACS mode.

Maximum size of queue =

Specifies the size, in blocks, of the queue file specified in the Qtemp = option. The file is established to collect test and analysis data that is sent to the central station after the board test is complete. The specification must be at least 5 blocks and is typically 20-50 blocks. Four blocks are used for each test. The contents of this buffer are routinely transferred to the central station. If the tester is unable to send the test results to central because of hardware or software problems, the results are stored in this buffer until central can respond. Thus, TRACS testing can continue during periods of momentary or scheduled shutdown of the central station or the GRnet network, but only to the extent that the queue buffer does not overflow. If, during TRACS operation, this file overflows, the following message is displayed and testing operation is aborted.

```
TRACS ABORTED DUE TO:
FULL QUEFILE OR QUEFILE TOO BIG TO FIT
FATAL ERROR
```

Board type =

The board type entry (24 alphanumeric characters max) can be either specified here or left blank. If it is not specified here, the operator is requested to enter the board type during the TRACS logon.

Process name =

This entry (15 alphanumeric characters max) is used as a tag to categorize collected data so that they can be grouped for later statistical analysis. Examples of a process name could be: PRELIM, SETUP, INCKT, PROTOTYPE, S39. If the process name is not specified here, the operator is requested to enter it during TRACS logon.

Suppress Messages [NO,YES]

[NO] Test result messages are displayed and printed in the same way as with non-TRACS testing.

[YES] Inhibits all test result messages from being displayed or printed. Since all data are sent to the central station, there is no need for the operator to know what problems exist on the board, nor any need to attach a printout to the board. Thus, testing time can be reduced.

If a very large error message file is created for a single board, some of the messages for components tested near the end of the test program may not be transmitted to the central station. In this case the untransmitted messages are not available for use in the TRACS system.

Analysis [NO,YES]

[NO] The default select which disables local analysis.

[YES] Enables local analysis and causes a prompt to appear, when a failure occurs in a test, which asks the operator to provide analysis data.

Qtemp =

Queue file located on the disk indicated by this specification. There must be sufficient free space on the disk to accommodate the data collection during normal TRACS operation. If not specified, Qtemp = defaults to the DEV = specification. The file name is permanently set to QUEUEFILE.TCS.

All other DIAGNOSE page options are described in para 4.5.

B.4 TRACS LOGON AND TESTING PROCEDURE

Before testing in the TRACS mode can be started, communications must be established between the test station and the TRACS central station. The procedure for doing this is called logon. Logon is accomplished by the operator's responding to the logon prompts that appear when the START button is pressed after the Diagnose page is filled out. The logon prompts appear on the display, as shown in Figure B-4.

B.4.1 Logon

Logon cannot be completed without board type and process type information. If these options are not entered on the Diagnose option page, a prompt appears that requests the missing information. Otherwise, the board type and process type information is displayed and the

Enter the operator ID:

prompt appears. Respond by typing in the ID code provided by the system manager or by scanning the appropriate bar code.

The central station knows the names previously authorized for use with this station. If the system does not recognize your ID and you believe it should, notify the system manager.

Once the ID is properly entered, the

Password:

prompt will appear on the display. Respond by typing in the password code provided by the system manager or by reading the appropriate bar code.

The central station knows the password assigned to each operator. The password must be entered exactly as previously defined. The password is not displayed on the screen as it is entered.

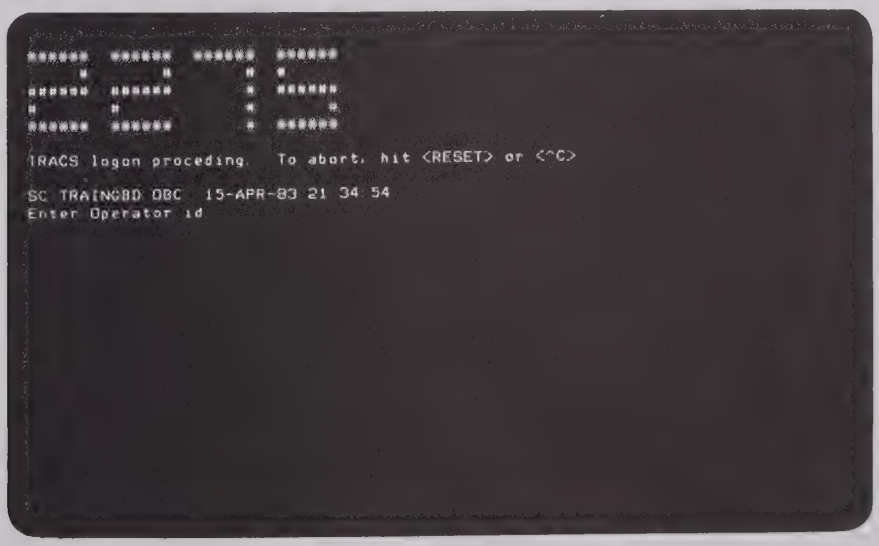

Figure B-4. TRACS Prompt Display.

After the password is entered, the central station checks the validity of the operator ID and password and then responds with either

```
Logged on to TRACS
```

indicating a valid Logon, or

```
TRACS ABORTED DUE TO
LOGON ERROR
FATAL ERROR
```

indicating incorrect ID, password, board type, or process name. The message

```
TRACS IS ACTIVE
```

also appears in the upper right-hand corner of the screen. If, however, the network or central station does not respond, the TRACS software that resides in the 227X causes the prompt

```
Not receiving from central. Please enter Master Password:
```

to be displayed. After the master password is properly entered, testing can proceed and the message TRACS QUEFILE IS ACTIVE appears. Normally, the system manager has the master password, which unlocks the 227X TRACS file management routines that would normally be unlocked by a message from the central station.

B.4.2 Testing

Once a valid logon is accomplished, the prompt

```
ENTER SERIAL NUMBER OR <RUN>
TEST]>
```

is displayed. Enter the serial number of the current board, using the keypad or the wand, and press RUN or START. If a new serial number is not entered and RUN is pressed, the system assumes the board is being retested.

When the test is complete, PASS or FAIL display appears on the screen:

```
BOARD SERIAL NUMBER=
```

and

```
Passes:  , Fails:
```

information is added at the right side of the display, as shown in Figure B-5. The test could then be run again or a new board could be tested. The passes and fails information, the number of tests that passed and failed during the current session, is displayed in the same manner as in non-TRACS testing. If the central station fails to respond immediately at the end of a test, the pass or fail display will include the message TRACS QUEFILE IS ACTIVE.

When one of the following conditions exists, Logoff must be executed.

```
A new operator is to continue testing.
Testing is to continue without using the TRACS feature.
The process type is to change.
A change is to be made in the use of TRACS analysis.
Need to change queue file size.
```

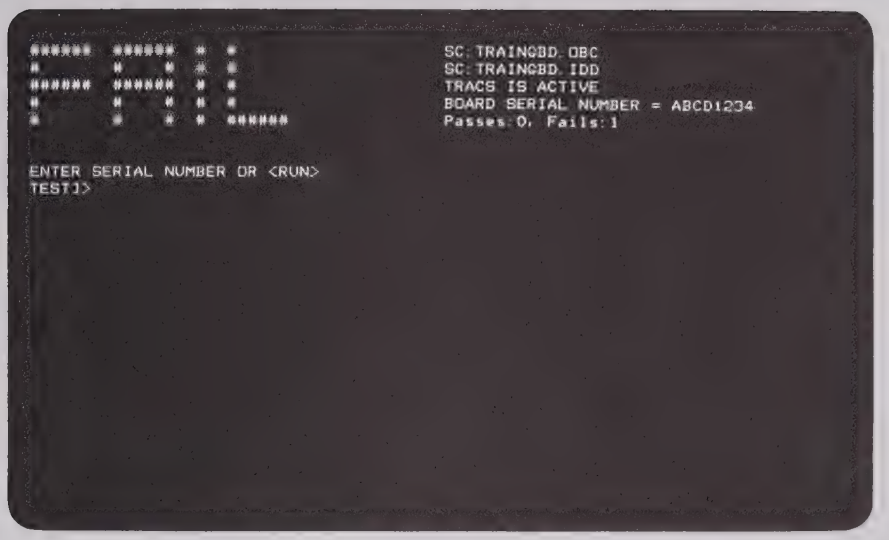

Figure B-5. TRACS Testing.

To logoff, return to the monitor. In response to the prompt

```
ENTER SERIAL NUMBER OR <RUN>
TEST]>
```

type MON

The Diagnose options page is displayed and you can logoff.

B.5 TRACS ANALYSIS

TRACS analysis is most commonly done at the various 2701 Production Workstations, but some local analysis can be done on a 227X test system. Local analysis consists of assigning defect and repair codes when a test failure occurs. Analysis is enabled on the Diagnose monitor page, Analysis [NO,YES] option, before the TRACS test mode is run. When Analysis is enabled, analysis code information is down-loaded from the central station to the test system at logon time. The operator selects defect and repair codes from this code information. The code information is changeable at the central station so it could vary between logons. Once analysis data have been entered for a test, they are ready to be sent to the central station.

When analysis is enabled and the user has logged on, the analysis mode display, shown in the example of Figure B-6, appears on the screen. This displays the first failure message so that it can be analyzed. A flow chart of the TRACS analysis process is shown in Figure B-7.

Several special keys allow the user to sequence through the information items in each failure message and through all of the failure messages associated with the board. The user can also edit the information displayed with each message: defect code, location, repair code and repair text. Pressing the HELP key displays a list of these special keys, along with a brief explanation of their function (see Figure B-8).

```
SN: ABCD1234          Total Failures:        Analyzed Failures:

ERROR MESSAGE:
**Shorted Nails**
11,143

11-May '82      13:52

        BOARD   NAME3   FAILED

-------------------------------------------------------------------------------

DEFECT CODE: 12
LOCATION: R9
REPAIR CODE: C
REPAIR TEXT: CORRECT SOLDER PROBLEM

ENTER DEFECT CODE FOR FAILURE _#1:

If you need assistance, press the <HELP> key
-------------------------------------------------------------------------------
```

Figure B-6. Example of Analysis Error Message Display.

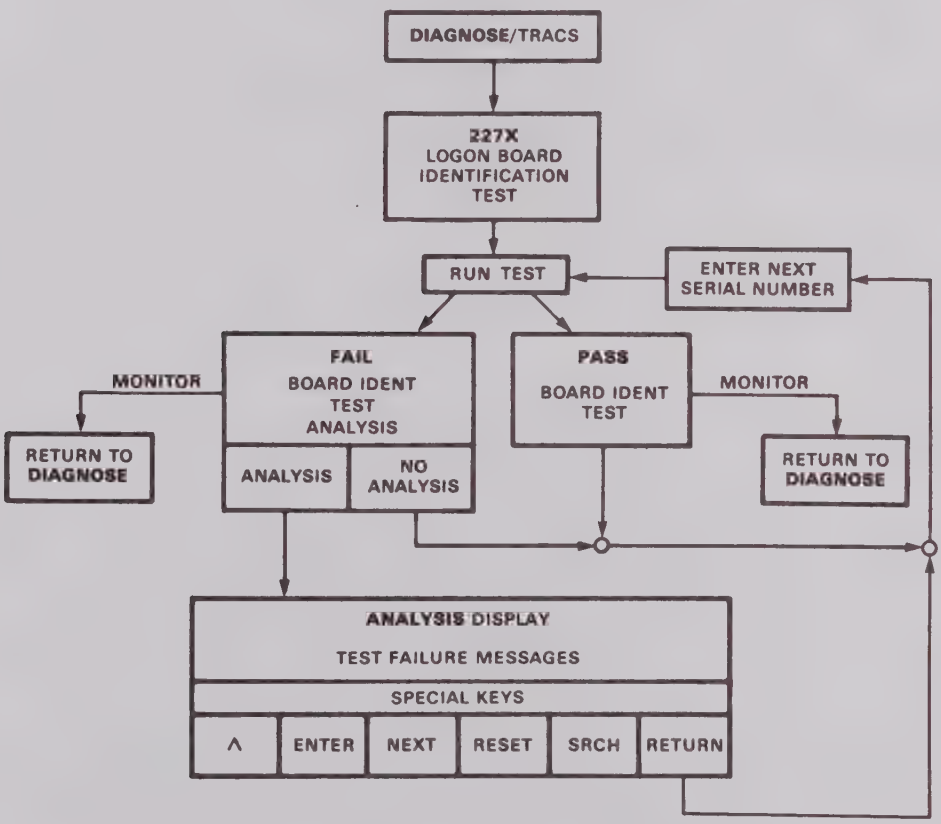

Figure B-7. TRACS Test with Analysis Process.

Pressing the "up-arrow" key displays the prompt for the previous item. Pressing ENTER or RETURN leaves the information at the current prompt unchanged and advances the prompt to the next item in the list. If more information exists than can be displayed on the screen at one time (as indicated by the word "more" at the bottom of the display), pressing the SRCH key will display the additional information. Pressing NEXT causes a skip to the display of the next failure message. Pressing RESET terminates the analysis of the board and allows the user to specify the board serial number for another test and analysis.

```
SPECIAL KEYS FOR TRACS ANALYSIS

<Up-arrow>      -Returns to previous prompt
<ENTER>         -Leaves answer the same and proceeds to next prompt
<NEXT>          -Skips current failure and proceeds to next failure
<RESET>         -Terminates TRACS analysis
<RETURN>        -Same as <ENTER>
<SRCH>          -Shows more of current failure text

Do you wish to list the DEFECT and REPAIR CODES? [Y/N]
```

Figure B-8. Special Keys for TRACS Analysis.

```
DEFECT CODES:
#BAREBOARD
Z - BAD ETCH

#ASSEMBLY
A - WRONG PART
C - MISSING PART
D - PART IN WRONG

#SOLDER
B - HAND SOLDER
E - MACHINE SOLDER

#COMPONENT
G - BAD PURCHASED COMPONENT
H - BAD TRANSISTOR
I - BAD DIODE
J - BAD DIGITAL IC
K - BAD LIN IC
L - BAD QR COMPONENT
M - BAD CAPACITOR

#OTHER
F - OTHER
N - NO DEFECT
```

To observe a list of the allowable defect codes and repair codes (Figure B-9), answer Y to the question

DO YOU WISH TO LIST THE DEFECT AND REPAIR CODES? [Y/N]

that appears at the bottom of the Special Keys display.

A Y answer causes the following question to appear:

SHOULD THE LIST GO TO THE (S)TRIP PRINTER,
(L)INE PRINTER OR (T)ERMINAL?

Select the desired output device by typing the letter S, L or T, as appropriate.

Pressing the NEXT key causes the next failure message to be displayed. After the last failure message has been displayed the following statement appears:

END OF FAILURE. DO YOU WISH TO EDIT ANY ENTRIES? [Y/N]
THIS IS THE LAST MESSAGE FOR THIS BOARD

Typing Y causes the system to re-display the failure message and prompts the user to modify any of the 4 types of entries: defect code, location, repair code and repair text.

```
REPAIR CODES:

#REPAIR
R - REPLACE COMPONENT
C - CORRECT SOLDER PROBLEM
I - INSTALL MISSING COMPONENT
E - REORIENTATE OR REINSTALL SAME COMPONENT CORRECTLY
P - PERFORM INDICATED REPAIR

#NO-REPAIR
N - NO REPAIR ACTION IS REQUIRED
```

Figure B-9.
Defect and Repair Codes.

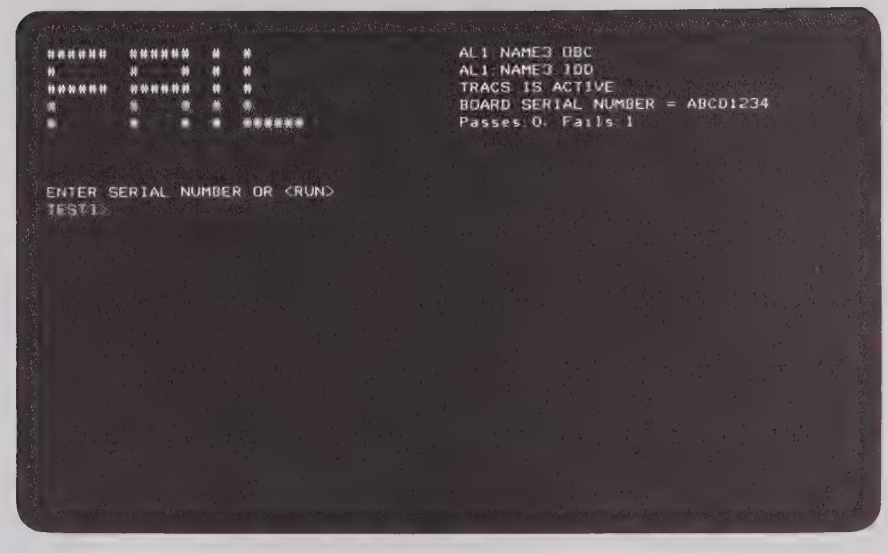

Figure B-10. Analysis Prompt Display.

Typing N causes the display shown in Figure B-10 to appear on the screen and lets the user enter the serial number of a new board, if desired.

Note that the system limits the number of defects that can be analyzed on a board to 15. Any failure messages beyond 15 are ignored. A board that had a very large number of failure messages during the test may not have had all its messages sent to the central station. In this case, the message indicated as the last failure message may not actually be the last message generated by the test.

B.6 TRACS ERROR MESSAGES

When an error occurs in a TRACS process, a 3-line message appears on the display. The first line is always

TRACS ABORTED DUE TO:

The second line is one of the following:

LOGON ERROR	Unrecognized operator ID or password.
FULL DISK QUEUEFILE	Queue file too full to accept more data.
DATA LOST	Central station did not receive data.
NO DISK QUEUEFILE	A TRACS queue file was not set up.
QUEUEFILE TOO BIG TO FIT	Not enough disk space for specified file.
LOGOFF ERROR	System had a problem logging off.
SERVER BUFFER FULL	Buffer that receives code data from central station is full.

The third line is always

FATAL ERROR

Any of these errors causes an automatic logoff to occur and information for the current board may be lost.

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